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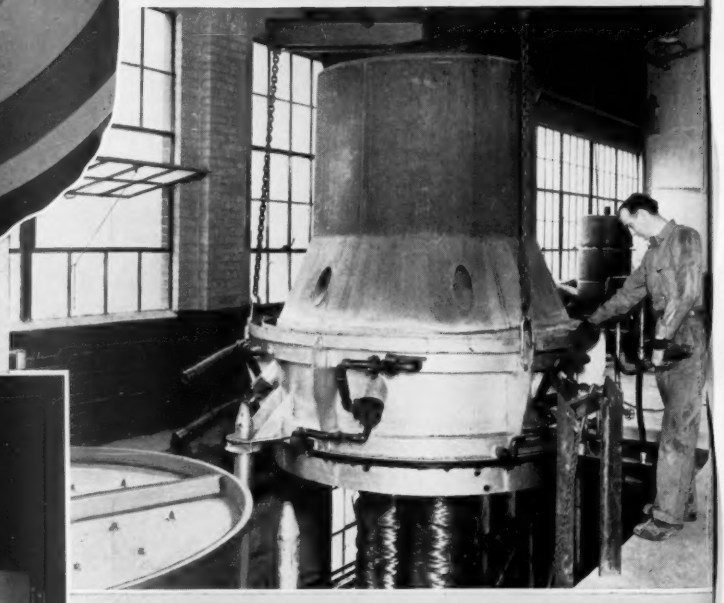

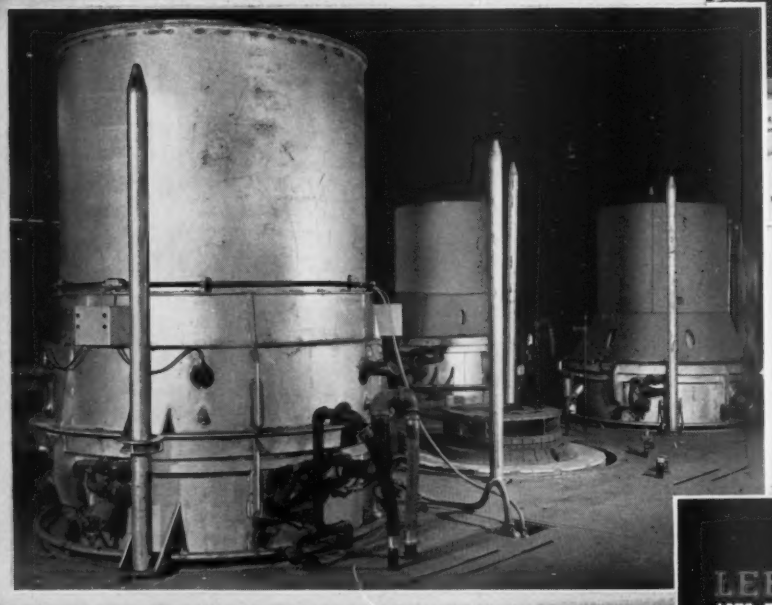

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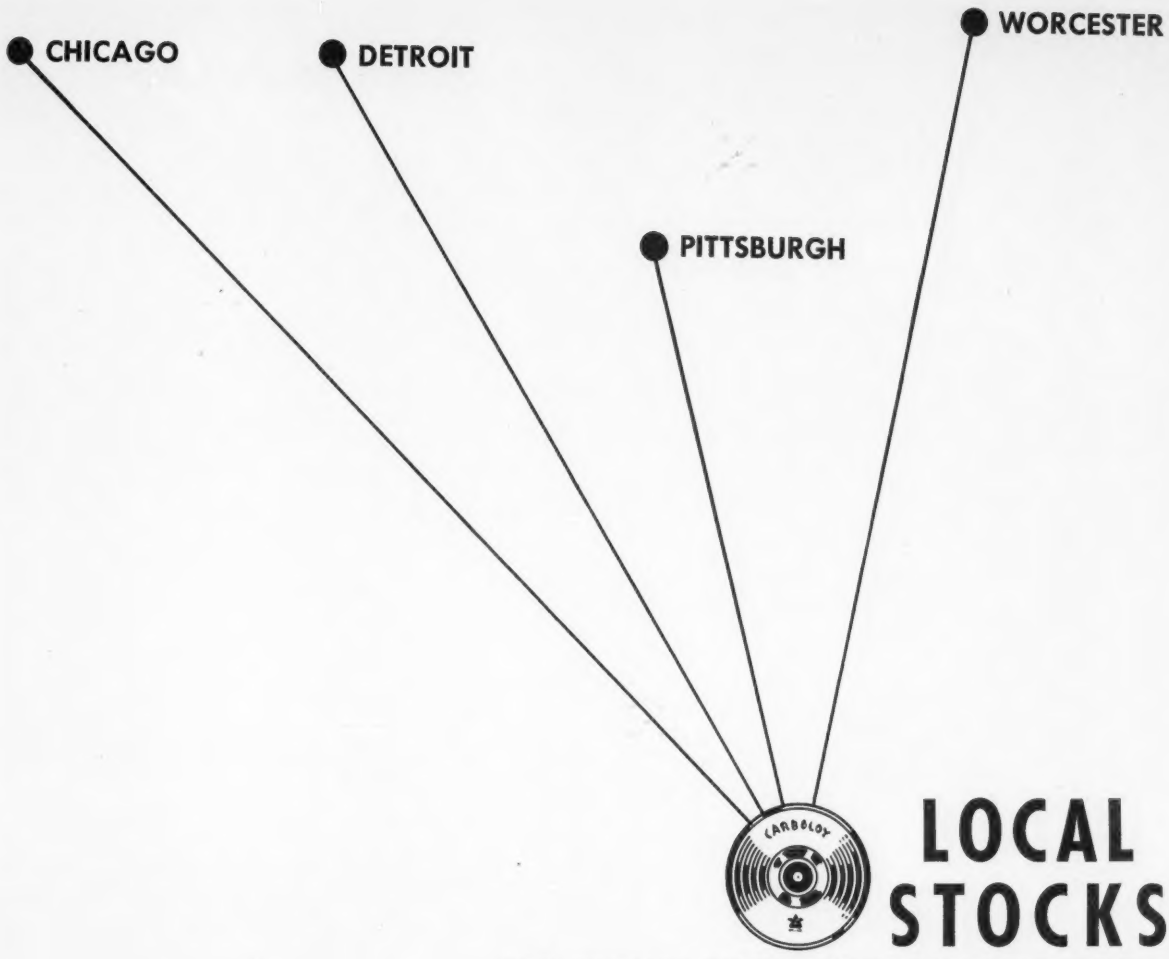

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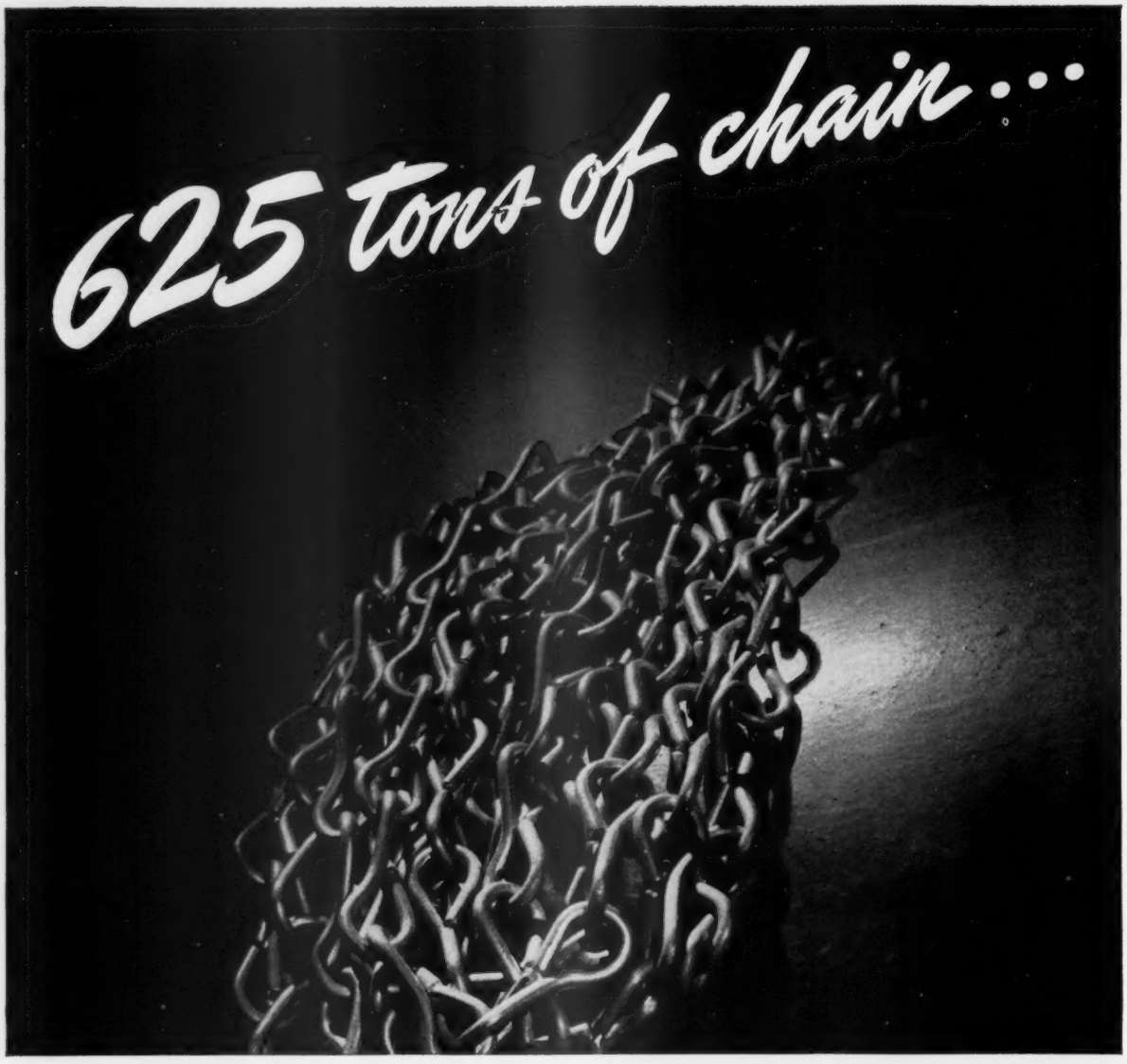

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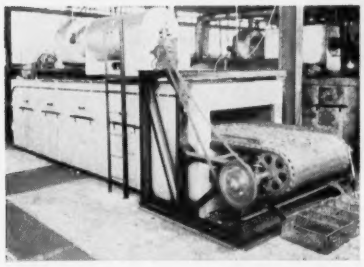

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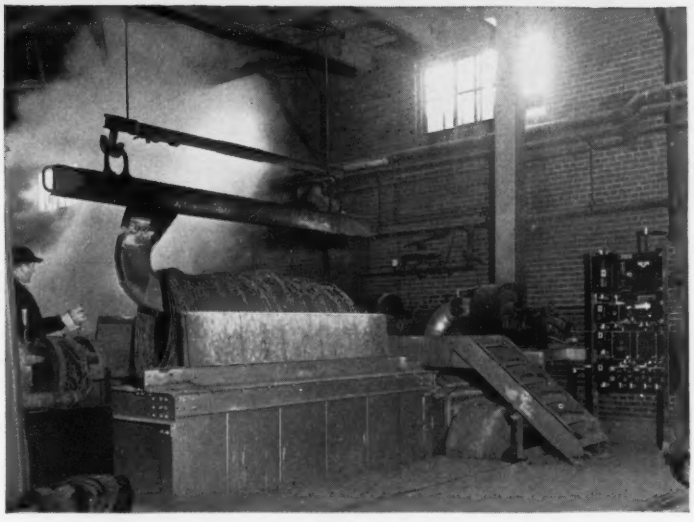

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6	"	"	"	11	"	"	"
8	"	"	"	10	"	"	"
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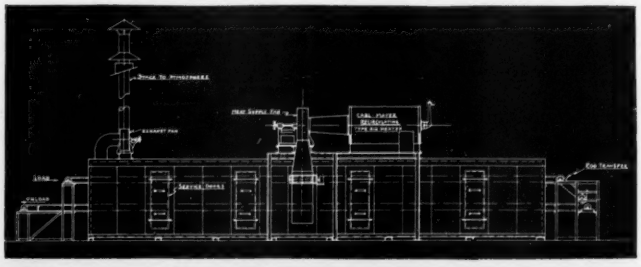

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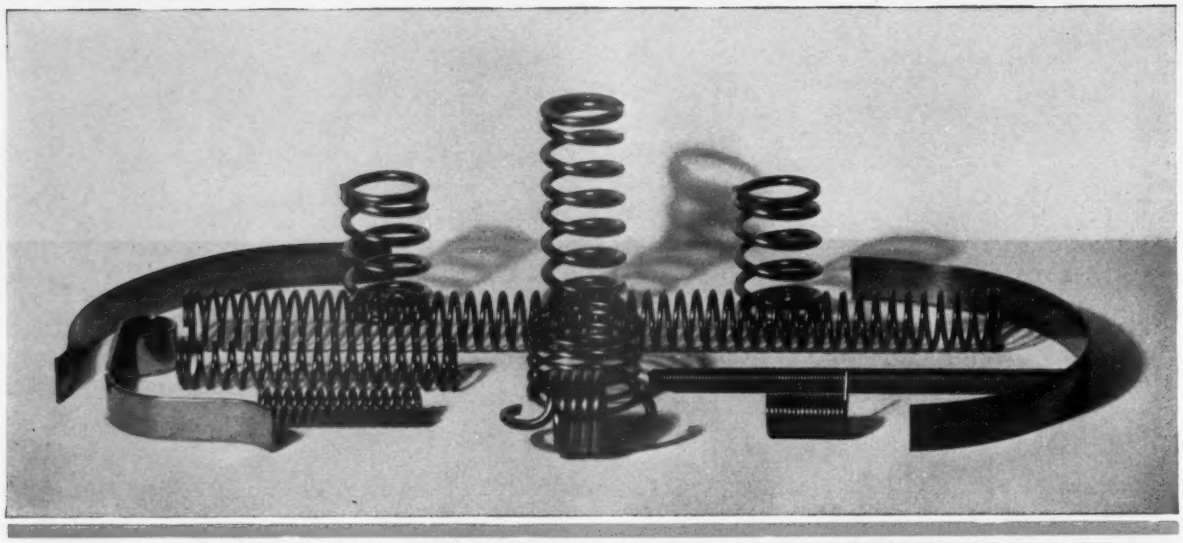

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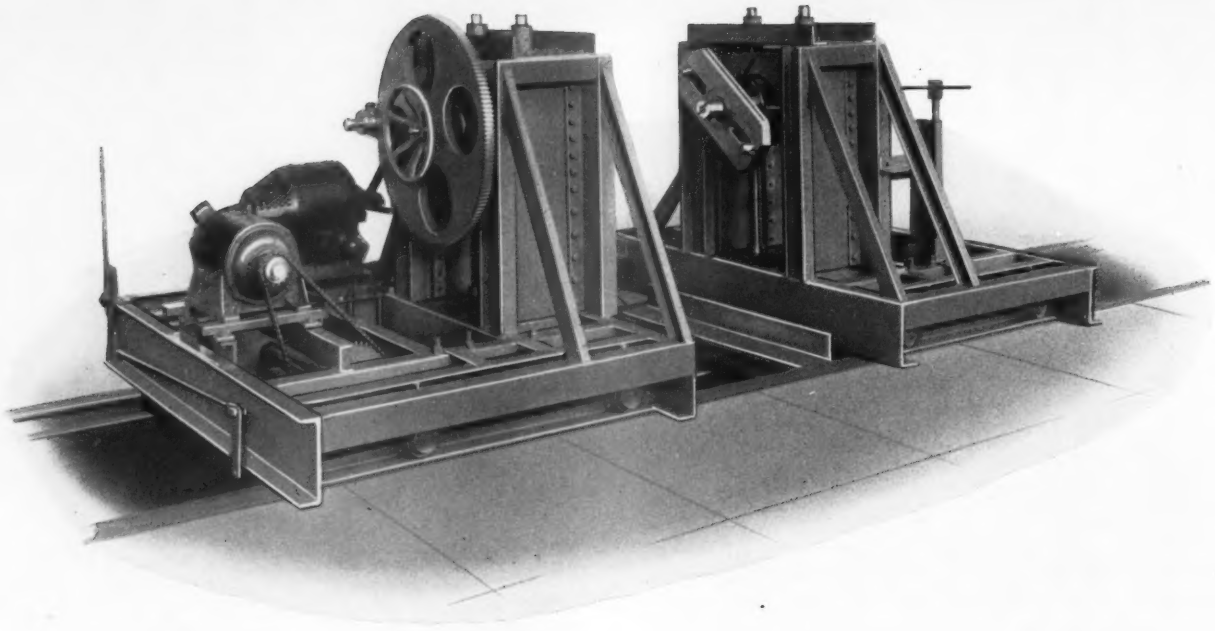

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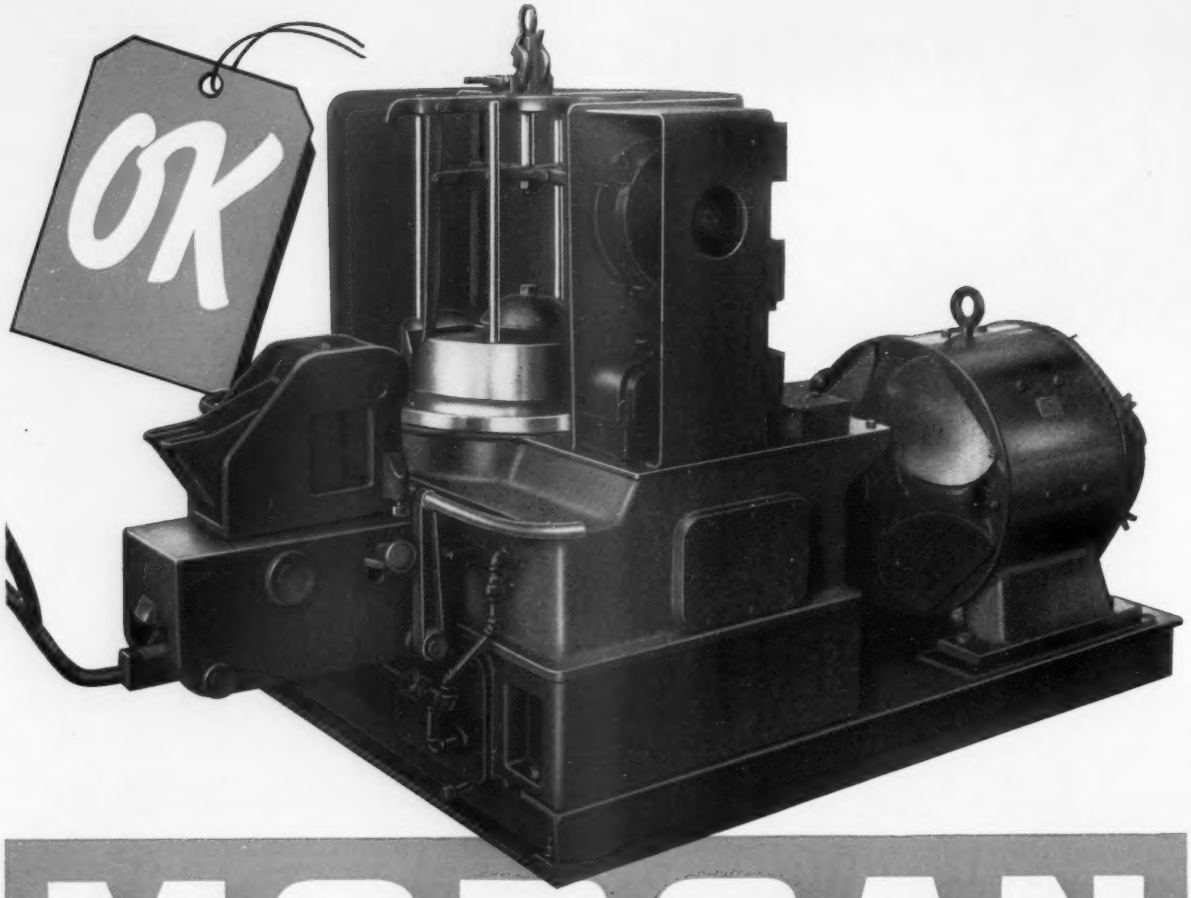

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 16 MARCH, 1941 No. 3

Designated as

Official Publication By The Wire Association

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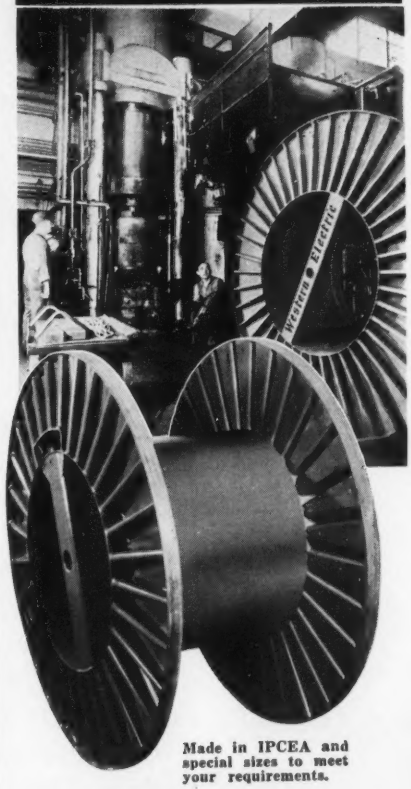

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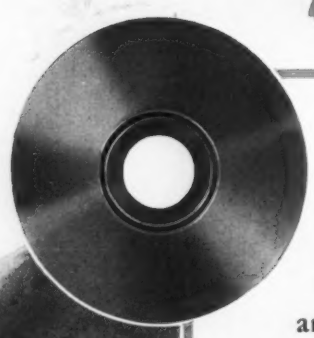

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 16 MARCH, 1941 No. 3

Grain Orientation As Exposed By X-rays

By S. Coppick,

Graduate Assistant, New York State College of Forestry,
Syracuse, New York

A contribution from The Canadian Steel Corporation, Ojibway, Ontario. ✦ ✦ ✦

MANY recent publications on the drawing of wire include X-ray diffraction patterns to illustrate grain orientation. Since this subject belongs to a very specialized scientific field, the "wire man" has had little opportunity to acquaint himself with the mechanism of this phenomenon. Most of the available explanations either presuppose a rather wide knowledge of X-ray diffraction or are content merely to illustrate the diagrams which represent certain grain orientations without explaining the why or wherefore of the phenomenon. This condition has resulted from the scientists' desire for exactness and reluctance to stray too far from the convenient method of mathematical expression of physical laws. Nevertheless, it is possible to explain almost all of the rarer types of electromagnetic phenomena by analogies with more widely known natural laws and by means of straight line drawings. It must be realized, however, that by such methods we stray slightly from the scientific truth but we must adopt the attitude that the end justifies the means. The following is an attempt to simplify the subject of X-ray diffraction and thus give the non-scientist a knowledge of the fundamentals of a subject which is of vital interest to the wire drawing industry.

SYDNEY COPPICK

Born: Fenton, England, Nov. 14, 1912. Graduated Chemical Engineering McGill University 1936. Potlatch Fellow at the University of Idaho 1936-37 where obtained Masters degree in chemistry. Demonstrator in Chemistry, McGill University 1937-38 and Graduate Assistant in the Pulp and Paper Department of the New York State College of Forestry at Syracuse 1938-41. Received X-ray training in the Department of Radiology of Syracuse University and the Polytechnic Institute, Brooklyn, N. Y. Received training in the wire industry with the St. Lawrence Wire Co., Montreal. Member, Eng. Inst. of Canada, Sigma XI, and Phi Epsilon Alpha. Now research chemist with the American Viscose Corp.

✦ ✦ ✦

X-RAY diffraction may best be explained by analogies using mirrors and the reflection of light from their surfaces. Let us first consider what happens when a horizontal beam of light falls upon a vertical mirror as shown in figure 1. If the reflected light is allowed to fall upon a screen, a bright spot will be observed at the level of the incident beam. When the mirror is oscillated at various angles to the vertical the reflected spot will trace out an arc on the screen. Hence, from the position of the spot on the screen we could determine the angle at which the mirror is inclined to the vertical.

✦ ✦ ✦

NOW, providing that we could find a suitably penetrating

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light we might embed our mirror in a block of concrete and still be able to determine its inclination as shown in figure 1. We have such a type of light, namely the X-ray,

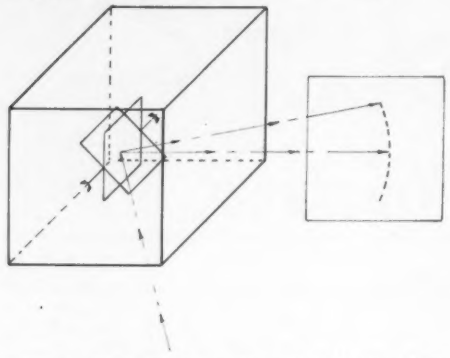

Figure 1. Representation of the path of a light beam, when the reflecting surface is oscillated through a small angle.

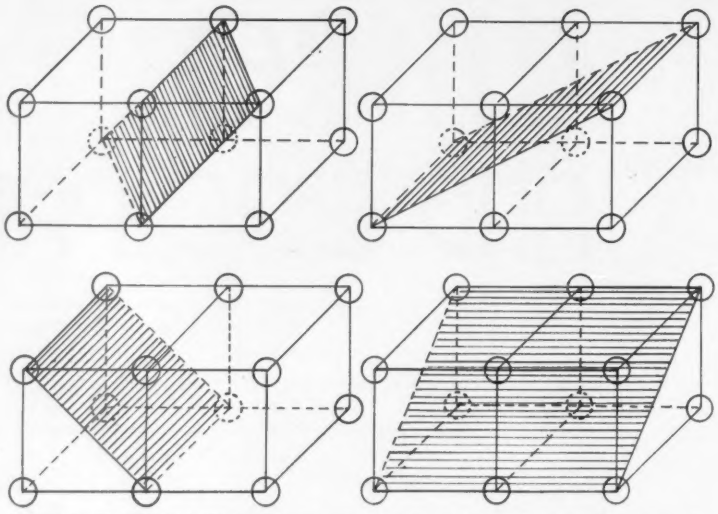

Figure 2. Hypothetical plane surfaces formed by the orderly arrangement of atoms in crystalline materials.

and in this discussion it will be best to consider the X-ray simply as a light beam with certain peculiar properties. Firstly, it will penetrate matter and be reflected from our mirrors embedded therein, but we have to replace our screen by a photographic plate since the eye is not sensitive enough to detect X-ray light. Next, we will require special mirrors. These are the plane surfaces which are formed by the orderly arrangement of the atoms in all crystalline substances as shown in figure 2. These planes are the hypothetical sections which might be cut from a crystal so as to expose atoms in the surface of the section.

✦ ✦ ✦

FOR X-rays to be reflected from these planes, it is not sufficient that we have one single mirror (plane), but we must have quite a number of these which must be parallel to each other and arranged at a constant distance apart. This is exactly the condition of the hypothetical planes between the orderly arrangement of atoms in crystalline substances. With ordinary light we have reflection no matter at what angle the light beam strikes a mirror, but with the X-ray this is not true. This type

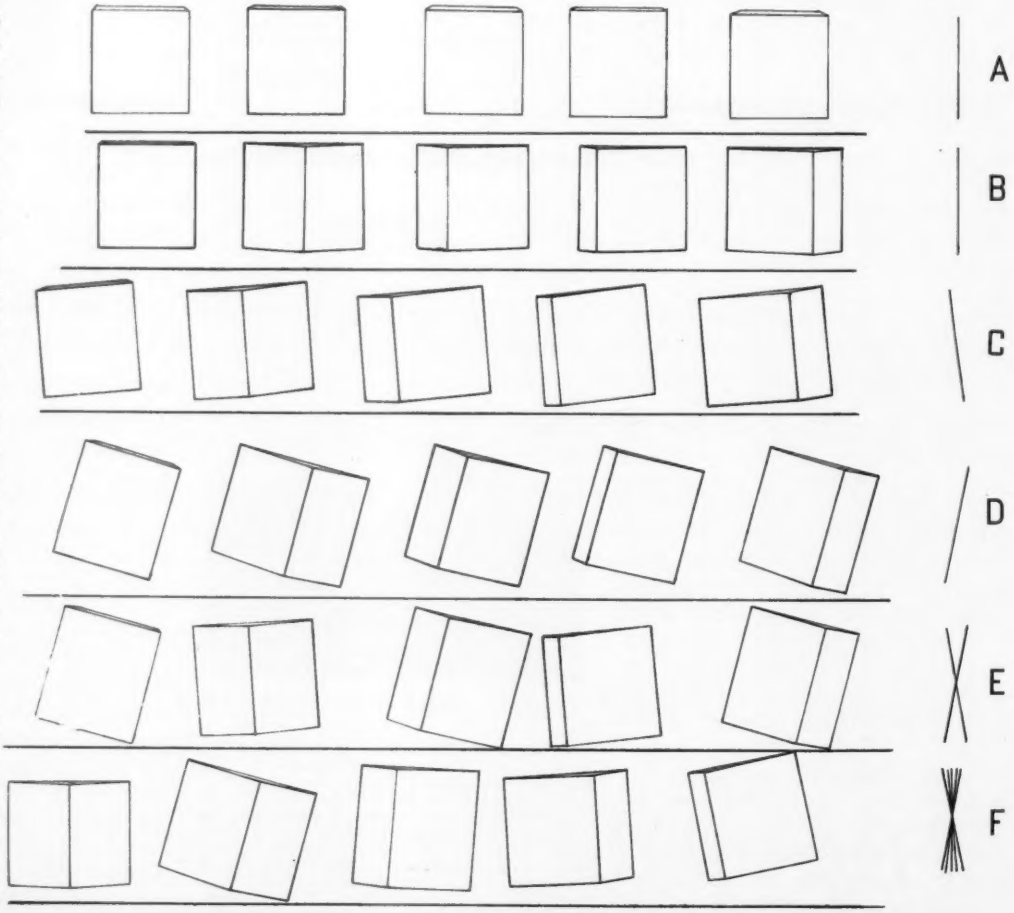

Figure 3. Various possible arrangements of crystallites in wire. Orientation of the grains is shown as decreasing from a to e.

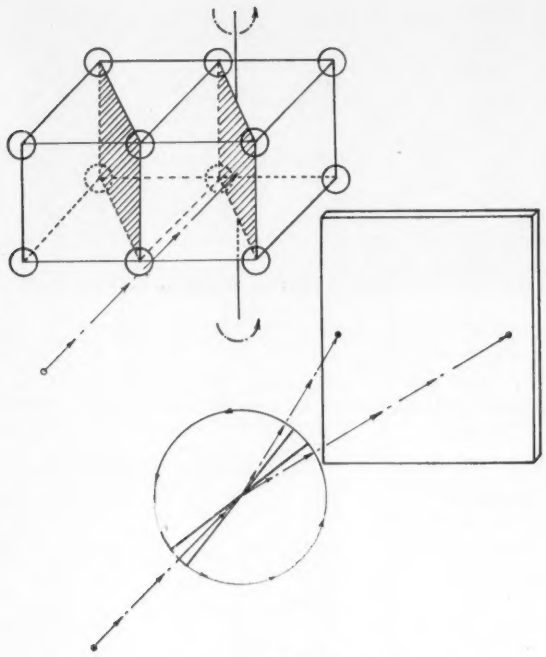

Figure 4.
(Condition of Figure 3b.)

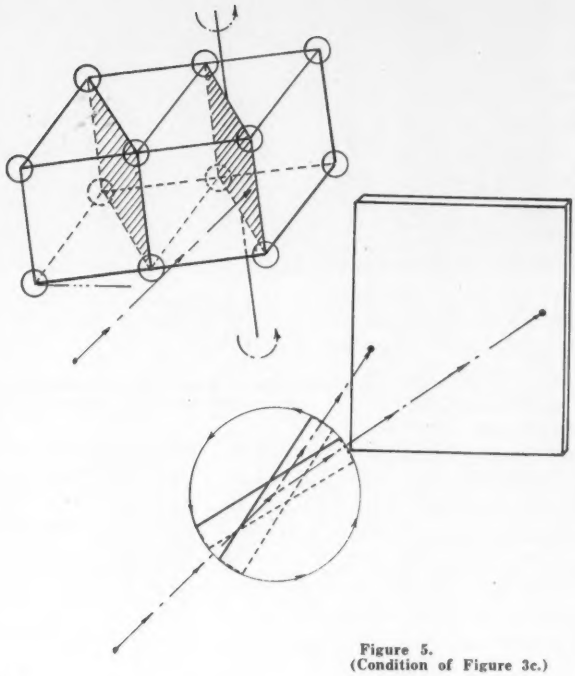

Figure 5.
(Condition of Figure 3c.)

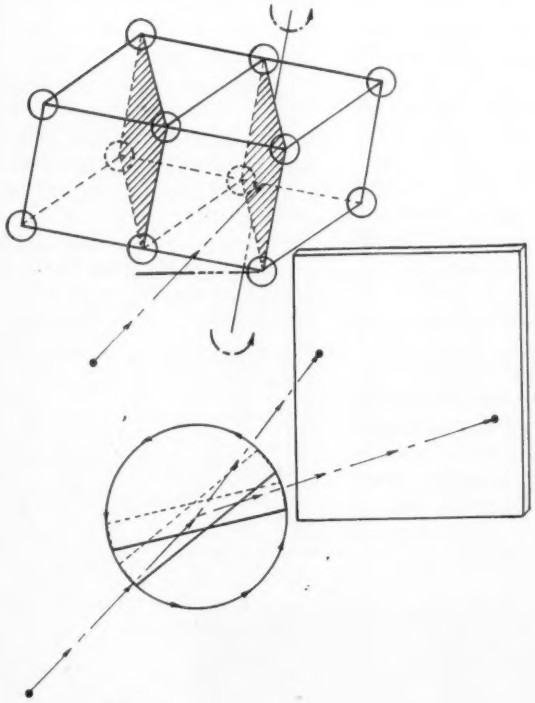

Figure 6.
(Condition of Figure 3d.)

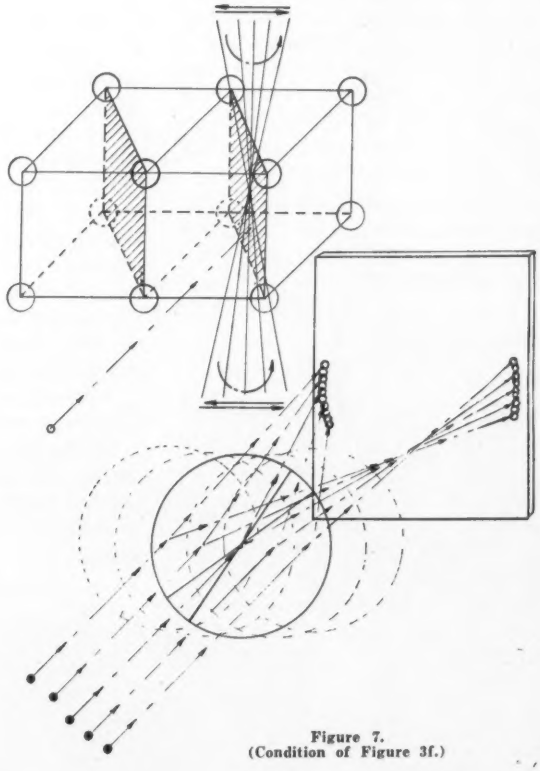

Figure 7.
(Condition of Figure 3f.)

of light is reflected for certain angles only, which depend upon the distance between the parallel mirrors. It is apparent that this distance will vary depending upon which type of plane we consider as in figure 2, hence for each set of planes there is a definite angle at which the beam must hit the planes before reflection takes place.

WE see then that the grains or crystals which make up wire contain planes which may be regarded as mirrors, and with our special type of light and screen

we should be able to determine how these mirrors are arranged in the wire in the same manner as we determined the inclination of the mirror embedded in concrete.

✦ ✦ ✦

FOR simplicity it will be better if we limit our examination to one set of the existing planes such as shown in figure 4. If we have the crystals or grains in the wire arranged as shown in figure 3a and send an X-ray beam longtitudinally through the wire, what will happen? The beam finds the equally spaced mirrors of figure 4, but these are not at the required angle. However, in passing through a wire in which the crystals are arranged as in figure 3b, the beam will certainly find a crystal in which the planes are arranged at the proper angle for reflection. This arrangement (3b) is the same as if we took a crystal of 3a and rotated it around the axis shown in figure 4. It is evident that as the crystal is rotated the plan of the planes follows the diameters of a circle and at some position the angle will be the correct one and reflection will take place. Furthermore, as both sides of the plane can reflect there will be two positions of reflection.

✦ ✦ ✦

OUR next consideration is that of crystals arranged with the test plane at a slight angle to the vertical as shown in figure 3c. The X-ray beam, during its passage through this structure, will fall upon some crystal in which the planes are at the proper angle. In figure 5 this condition is again demonstrated by rotating the planes around an axis. However, here the plan of the plane is not a line but is a rectangle since the planes are inclined to the vertical. Thus at the proper angle there will be reflection above the horizontal beam, and then below for reflection from the opposite side of the plane.

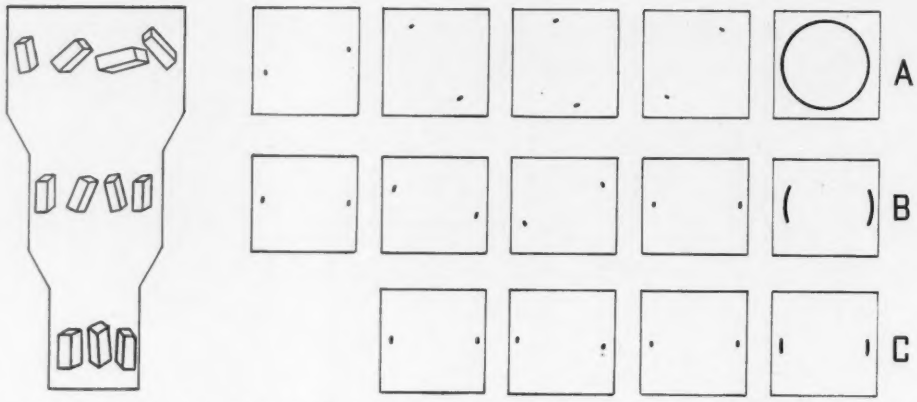

Figure 8. Orientation of grains during drawing. Diffraction patterns are given for a single plane in each of the grains. The right hand diagram is the resultant of the diffractions of all the grains. ✦ ✦ ✦

✦ ✦ ✦

SIMILARLY, for structures such as illustrated in figure 3d the opposite effect will be obtained as shown in figure 6. If as in figure 3e we have the planes inclined in both directions to the vertical we will have a summation of the patterns of figures 5 and 6. Now if we have the condition of figure 3f where plane inclinations of 3c, 3d and all other intermediate inclinations are represented, we will have all the intermediate reflections and the result will be that shown in figure 7, where we not only suppose the crystal plane to be rotated to get the plane at the proper angle, but we also assume that it is oscillated through a small angle about an axis through the considered plane.

✦ ✦ ✦

IF the crystals and hence their planes are arranged in any "helter skelter" manner in a wire this will be the same as rotating a crystal in an X-ray beam and also oscillating it not through a small angle as before but this time through a complete circle. Thus the plane under consideration would reflect the beam not in a small arc but a complete circle would result as the trace on the photographic plate.

✦ ✦ ✦

IT is now apparent that the arrangement of crystals in a wire may be determined by the diffraction diagram of one of the planes. Arrangements such as 3b will give a spot, those of 3f an arc and further inclinations of the planes from the vertical will widen the arc until in the limit it becomes a circle.

✦ ✦ ✦

OTHER planes in the crystals will not interfere with this method. For other sets of planes we will have a different distance between the planes and hence the angle at which reflection can take place will be different. This will mean that the distance between the center of the photographic plate and the reflected spot will differ for different sets of planes.

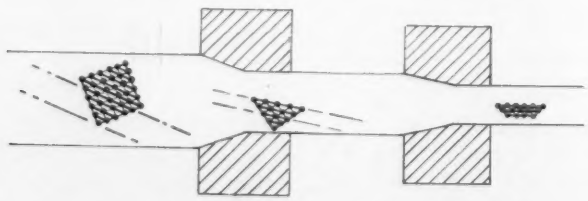

Figure 9. Orientation during drawing due to slipping along a diagonal plane. ✦ ✦ ✦ ✦ ✦ ✦

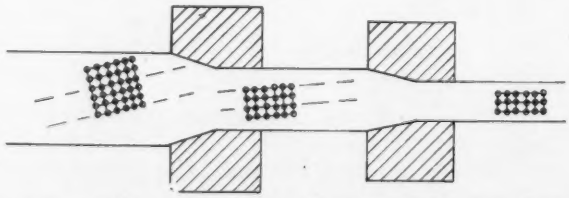

Figure 10. Orientation during drawing due to slipping along a horizontal plane. ✦ ✦ ✦ ✦ ✦ ✦

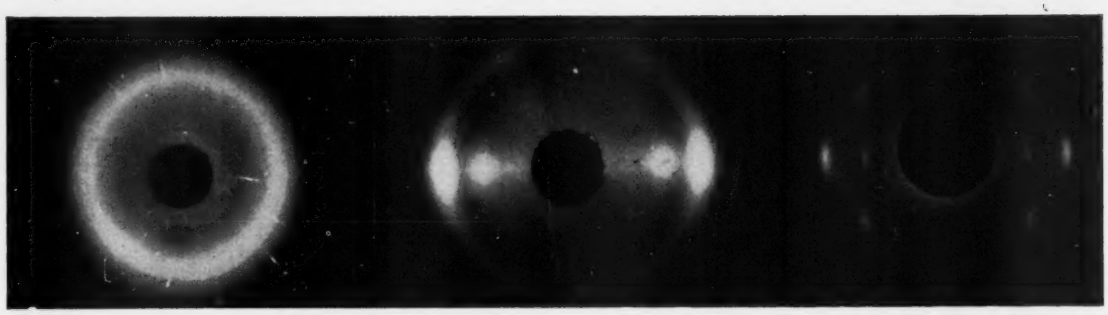

Figure 11. Diagram for a non-oriented material, as shown by the bright circles. (Condition of Figure 8a.)

Figure 12. Diagram for a partially oriented wire, as shown by the large bright arcs of circles. (Condition of Figure 8b.)

Figure 13. Diagram of a well oriented wire, as shown by the short bright arcs. (Condition of Figure 8c.)

Planes such as those shown in figure 4 will give spots on the same line on the plate but their distances from the center will vary, since the planes are not all the same distance apart. This also is true of the inclined planes in the crystals, as in figure 2 which always give spots inclined at positions other than the vertical or horizontal axes of the plate. However, all of these planes will show the same arcing when they are tilted. As before, the arc length gives us the degree of orientation of crystals.

✦ ✦ ✦

FIGURE 8 depicts this condition during the drawing of wire. Here, for clarity, all diffraction spots except those due to a certain set of planes have been omitted. The crystals are shown as orienting themselves during drawing. That is, the cementing material between crystals fractures and the crystals are drawn into line. The diagram pictures this as being accomplished in two drafts, however, many more are required for complete axial orientation. The diagrams are given for a certain plane in each crystal. The right hand diagrams are the summative diagrams for all the crystals.

THE above mechanism is, however, not the only method by which planes may line up during drawing. Slipping of crystals is known to take place readily along certain planes of atoms. Figures 9 and 10 represent orientation during drawing accompanied by a reduction in grain size. Which particular set of planes that is brought into line will depend upon the ease of slipping, which differ for different metals.

✦ ✦ ✦

IT should be remembered that in all our considerations thus far we have assumed that when the X-ray beam travels through the wire it travels through numerous crystals and finds them in all orders of rotation about the vertical axis. This condition we have represented by assuming a given crystal to be rotated about the plane under consideration. However, for large grain sizes this is not exactly true, so that we will not have uniform circles, but spots scattered on the circumference of circles since there are not sufficient crystals in the path of the beam to make the theory universally applicable. Thus in annealed wires we will not have very well defined circles. Nevertheless, during the first few drafts the crystals are broken up sufficiently so that the circles become very apparent, and from then on, the orientation of the crystal planes may be studied by the shortening of the arcs which replace the circles during further drafting.

✦ ✦ ✦

FIGURES 11 to 15 illustrate actual X-ray patterns obtained from wires judiciously chosen to illustrate some of the conditions and degrees of orientation commonly met with in wire drawing. Although in some cases the patterns are not quite as well defined as one would expect from the theory, differences in methods of drawing and composition are apparent. An explanation for each of the obtained diagrams is given with the pattern.

✦ ✦ ✦

Acknowledgment

The writer wishes to express his appreciation to the St. Lawrence Wire Division of the Dominion Steel and Coal Corp. for the supply of samples illustrated in this paper. Also to Dr. A. J. King of the Department of Radiology, Syracuse University, many thanks are due for his kind advice.

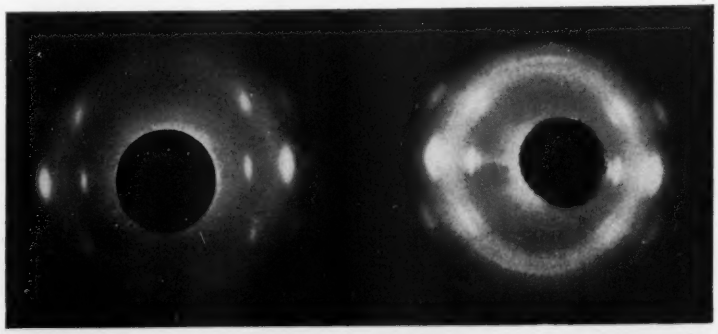

Figure 14. Diagram for a wire containing a large number of well oriented grains as shown by the short bright arcs, and also containing a small amount of non-oriented material as shown by the faint circles. (A mixture of conditions of Figures 8a and 8c.)

Figure 15. Diagram for a wire containing well oriented grains as shown by the short bright arcs, as well as considerable amounts of non-oriented materials as shown by the bright circles. (A mixture of conditions of figures 8a and 8c.)

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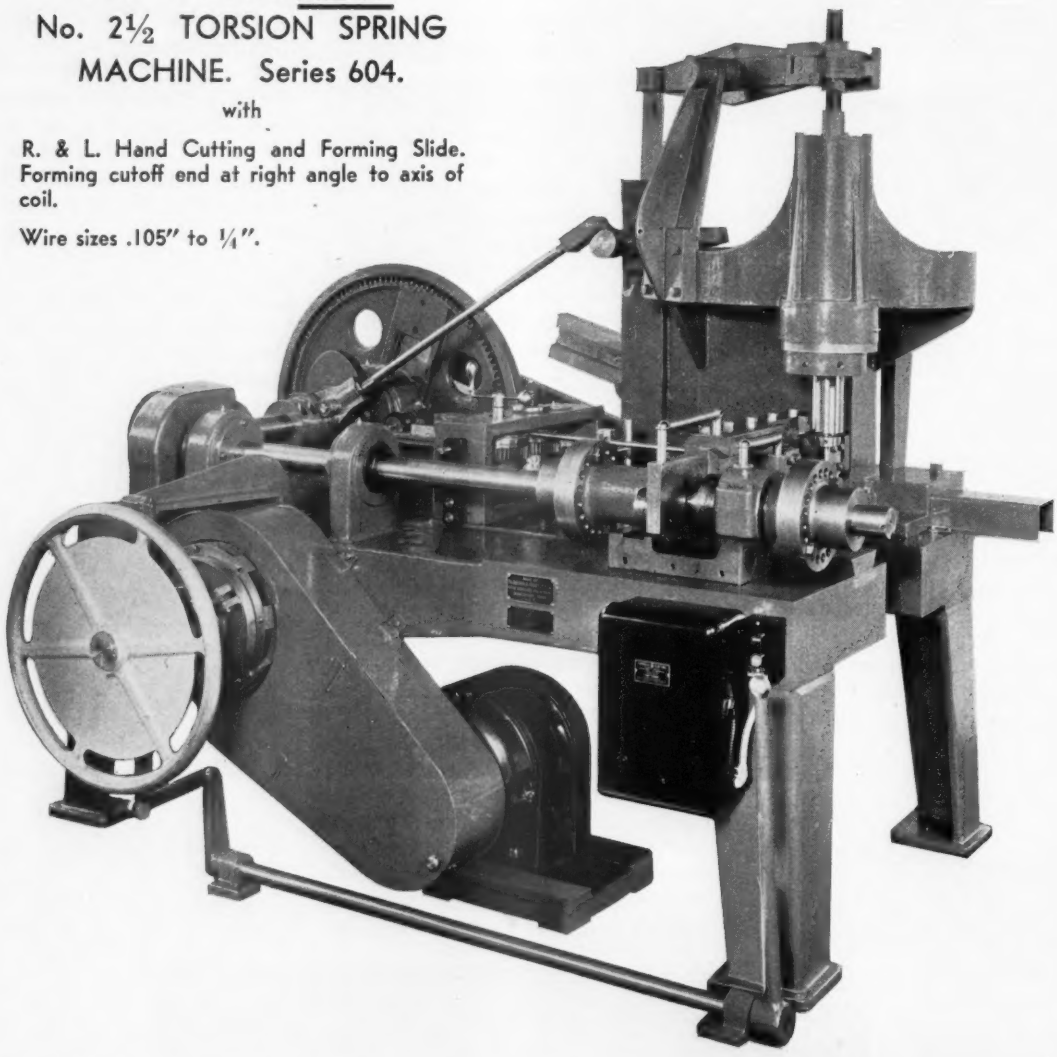

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The Mechanics of the Torsion Spring

PART I.

By Robert L. Adams,
Barnes-Gibson-Raymond Div.,
Associated Spring Corp., Detroit, Mich.

FOR many years the equations used by the spring industry for the design of torsion springs, i.e. springs which develop a direct rotational or torque load have been based upon straight beam theory. This assumption was obviously incorrect but the calculations were accurate enough for springs with a high ratio of mean diameter to wire size. Within the last few years many articles have appeared in which the theory of curved beams has been applied to the torsion spring with the result that there are now numerous stress and deflection equations carrying corrections for curvature. However, most of these equations have been left in complicated, bulky forms and very little experimental testing has been done to establish their validity.

✦ ✦ ✦

THE purpose of this investigation was to develop a deflection and a stress equation based upon correct theory and so simplified that designers unfamiliar with spring calculation could use it safely and without confusion. It was also considered desirable to supplement the equation development with extensive testing of springs in order to observe and explain the effects of curvature, to establish whether or not the theory holds for both winding up and unwinding springs, and to compare the properties of springs used as coiled with those of springs heat treated after coiling.

✦ ✦ ✦

A SUMMARY of the results of this work shows that:

1. The most nearly correct equation for calculating deflections of torsion springs is

$$n = \frac{10.18\ D\ N\ M}{E\ d^4}$$

in which

n = number of turns the spring is rotated
D = pitch diameter of the spring
N = number of active coils in the spring
M = applied moment (in #)
E = modulus of elasticity in tension
d = wire diameter

2. The most nearly correct equation for calculating stress is

$$S = \frac{M\ c}{I} K$$

in which

S = stress (#/sq. inch)
M = applied moment (in #)
c = distance from extreme outer fibres to neutral axis
I = moment of inertia of the cross section
K = curvature correction factor
The derivation and use of K will be explained later.

3. The theory holds for both winding up and unwinding.
4. Drawing of prehardened wire is a very decisive factor when considering the ability of a spring to unwind. It also appears to produce a spring of somewhat higher elastic limit when being wound up than that developed by a spring of the same material which has not been heat treated; provided, of course, that the drawing temperature is not so high as to lower the physical properties of the material.

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IN approaching the problem of calculating stresses and deflections, a thorough study of end conditions was made in an attempt to establish the true load conditions on the spring.

✦ ✦ ✦

THE assumption of a tangential load, which has been much used, did not seem logical for several reasons. The development of this line of thought is based on tangentially loading a half coil built in at one end, as in Fig. 1, calculating the vertical deflection of A with respect to B, and multiplying by 2 to get the deflection for a full coil. This equation will give a deflection about 50% too high when compared with actual tests of torsion springs. In reality the deflection calculated by this equation is not a true rotational deflection, the elastic curve of which is a true circle, such as takes place in a torsion spring, but a deflection of the nature shown in Fig. 1. There is also a horizontal component to this deflection which is usually neglected, but which may be of considerable magnitude. If this type of loading is applied to a helical torsion spring of more than one coil, built in at one end and with no arbor in the center, the deflection calculated by using the above reasoning would be of the nature shown in Fig. 2 and not the rotational deflection in which we are interested.

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COMMERCIALLY, torsion springs are practically always used on an arbor and this changes the load condition to what is believed to be similar to a curved beam built in at both ends with practically a pure moment load and little if any tangential load.

✦ ✦ ✦

FIG. 3 shows a simple ¾ coil spring held in typical fashion and working on an arbor. The applied moment here would be P l since l is the lever arm on which the load is applied. This force is applied normally to the load circle and can have no tangential component. If the object applying the force P moves in a straight line as shown, it must slide on

the arm A—B and its effective component remains normal to the arm and the only tangential force existent would be frictional.

✦ ✦ ✦

IN other cases the load P is applied by a pin rotating about the same axis as the spring, and in this case P remains normal to the lever arm.

✦ ✦ ✦

A VERTICAL reaction P is furnished by the arbor at A. This gives a shear force, P acting from A to B, but this force also can have no tangential component and can produce no moment.

✦ ✦ ✦

THE test springs used were held by two different methods. The first method consisted of short arbors which fitted tightly into the end of the spring and were so shaped that the number of active coils was known. The second method was a chuck grip device which held an end brought across a diameter, giving a condition similar to the slotted arbor shown in Fig. 3. These are shown in Figs. 4 and 5. The tests were run with no arbor in the spring, since both methods of gripping the ends gave very nearly the same load conditions as is developed from Fig. 3. To avoid confusion we had best develop this again for both types of ends as we will later attempt to prove that it is correct by correlating the experimental results with the mathematical theory.

✦ ✦ ✦

FOR the arbor type ends the load condition would be as shown in Fig. 6. For the sake of clearness only a half round arbor and portion of the end coil are shown. While winding the spring up the end is, for all practical purposes, analogous to that of a curved built in beam. Fig. 6 (b). The forces acting on the built in end A B are shown in the free body sketch Fig. 6 (c). The radial forces at A and B act as a couple to produce a moment which is constant throughout the length of the spring, and the force P produces a maximum moment of PD/2 where D is the mean diameter of the spring. It will be shown presently that the tangential force P is negligible, if existent, for this case also.

✦ ✦ ✦

FOR the grip type ends we have a condition as shown in Fig. 7. This clearly results in a pure couple and, as can be seen from the free body sketches (b) and (c) the load is a pure moment M which is constant throughout the length of the spring. This type of end fixture was used so that the springs might be unwound as well as wound up. The arbor type ends could not be used for this purpose as the load upon unwinding was purely tangential at both ends so that the spring had no stability whatsoever. A further argument for the belief in a constant moment is the fact that a torsion spring deflects an equal amount on each coil when wound up and when deflected to the point where permanent deformation takes place the set appears to be uniformly distributed throughout the length of the spring. If a spring of 8 or 10 coils is wound up enough so that it retains a noticeably smaller diameter when relaxed it will be found that the change of diameter is uniform throughout the length of the spring and that the coils remain true circles. If a constant moment did not exist the set would occur at a point of maximum bending moment.

✦ ✦ ✦

THIS argument was further checked by setting up a spring so that it was tangentially loaded at the free end and built in at the other. The set in

Fig. 1

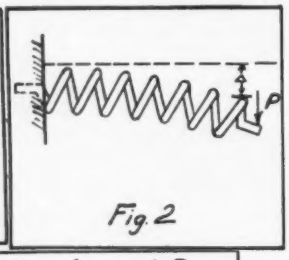


Fig. 2

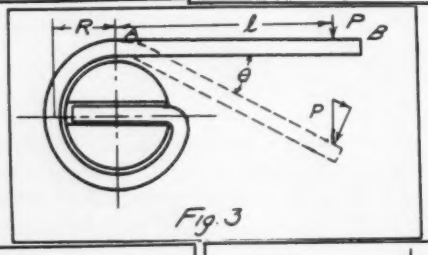


Fig. 3

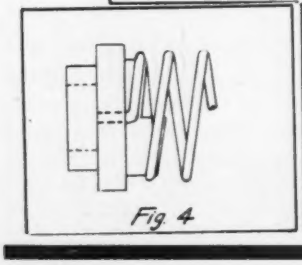


Fig. 4

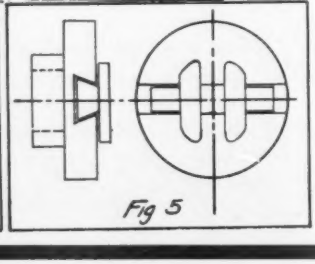


Fig 5

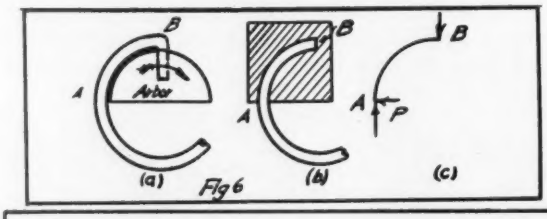


Fig 6

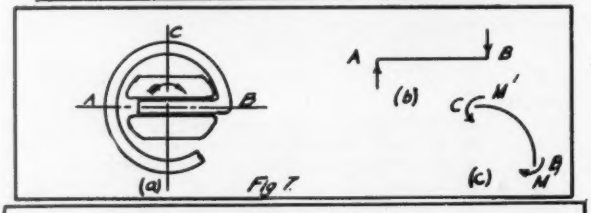


Fig 7.

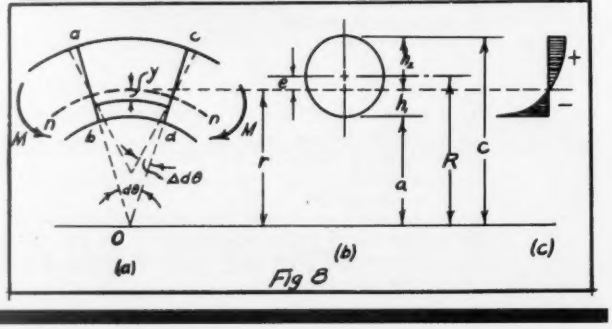


Fig 8

this case actually did occur in a localized area indicating the existence of a maximum moment.

✦ ✦ ✦

OUR next step will be to develop a stress and deflection equation from curved beam theory, compare them with straight beam equations, then correlate them with the experimental results. The development of this theory may be found in any good textbook on the strength of materials, but in order to show its application to our problem the complete development for a curved beam of circular cross section will be shown.

✦ ✦ ✦

LET a b and c d represent neighboring cross sections of the bar, and d θ the angle between them before the moment M is applied. Δ d θ will then be the angle of rotation caused by M and will result in tensile stresses in the outside fibres and compressive stresses in the inside fibres. These are the conditions existing in a torsion spring when it is being wound up. If n — n (dash line of radius r) represents the neutral axis, the elongation of any fibre at a distance y from the neutral axis will be $y\Delta d\ \theta$ and the resulting unit elongation will be

$$\varepsilon = \frac{y\Delta d\ \theta}{(r-y)\ d\theta^1} \qquad (1)$$

r being the radius of the neutral axis and (r—y) the length of the fibre before bending. Now since $S = E\varepsilon$, the bending stress in the fibre at a distance y from the neutral axis will be

$$S_x = \frac{E\ y\ \Delta\ d\theta}{(r-y)d\ \theta} \qquad (2)$$

✦ ✦ ✦

IN this case S_x is a compressive stress. For fibres outside the neutral axis S_x will be a tensile stress and equation (1) becomes

$$S_x = \frac{E\ y\Delta d\theta}{(r+y)\ d\theta} \qquad (3)$$

By reversing the moment M it can be seen that the stresses are also reversed but that no changes have been made in the development, therefore, our final equations will be independent of the direction of the moment and will hold for springs being unwound as well as wound up.

✦ ✦ ✦

EQUATION (2) contains two unknowns, r and $\Delta d\theta$ so we must resort to two equations of statics for a solution. The sum of the normal forces distributed over a cross section must be equal to zero gives us our first equation. The second is based upon the fact that the sum of the moments of these forces must equal the applied moment M. The equations are shown below.

$$\int S_x\ dA = \frac{E\Delta d\theta}{d\theta} \int \frac{y\,dA}{r-y} = 0 \qquad (4)$$

$$\int S_x\ y\ dA = \frac{E\Delta d\theta}{d\theta} \int \frac{y^2\ dA}{r-y} = M \qquad (5)$$

THESE integrations must cover the entire area of the cross section. Simplifying equation (5), and solving for S_x we have:

$$\int \frac{y^2\ dA}{r-y} = -\int \left(y - \frac{ry}{r-y}\right) dA = -\int y\,dA + r\int \frac{y\,dA}{r-y} \qquad (6)$$

✦ ✦ ✦

THE first integral on the right hand side of equation (6) represents the moment of the cross sectional area with respect to the neutral axis, and the second equals zero. (Eq. 4)

Therefore

$$\int \frac{y^2\ dA}{r-y} = A \qquad (7)$$

Where e denotes the distance from the centroid of the cross section from the neutral axis. Substituting this value into Eq. 5 and transposing we get

$$\frac{E\ \Delta\ d\theta}{d\ \theta} = \frac{M}{Ae} \qquad (8)$$

and Eq. 2 becomes

$$S_x = \frac{M\ y}{A\ e\ (r-y)} \qquad (9)$$

✦ ✦ ✦

THE stresses which we are interested in when designing a torsion spring are the maximum stresses which occur in the fibres at the inside and outside of the coil. These are the fibres farthest from the neutral axis and are

$$S_I = \frac{M\ h_1}{A\ e\ a} \quad \text{and} \quad S_o = \frac{M\ h_2}{A\ e\ c} \qquad (10,11)$$

where S_I is the maximum compressive stress and S_o the maximum tensile stress for a moment applied as shown in Fig. 8.

✦ ✦ ✦

IT can be shown that

$$e = R\frac{m}{1+m} \qquad (12)$$

where R is the mean radius of the curved beam and m is a constant dependent upon the section shape and the ratio of the section depth to R. For a circular section m may be calculated by Eq. 13.

$$m = 1/4\ \left(\frac{d}{D}\right)^2 + 1/8\ \left(\frac{d}{D}\right)^4 + 5/64\ \left(\frac{d}{D}\right)^6 \qquad (13)$$

in which d is the diameter of the section and D the mean coil diameter when applied to springs.

✦ ✦ ✦

IT can be seen from Eq. 2 that the stress distribution is no longer linear as in a straight beam but is of a hyperbolic nature. This condition is shown in Fig. 8, c. If the neutral axis does not coincide with the center of gravity of the section a linear distribution could not exist, since such a condition could not satisfy Eq. 4.

✦ ✦ ✦

IT was next desired to derive a correction factor for the straight beam stress equation, Eq. 14, as

$$S = \frac{Mc}{I} = \frac{10.2\ M}{d^3} \qquad (14)$$

it is a very simple equation to use. Two factors are required; one for stresses at the inside of the coil, and one for stresses at the outside of the coil. The factor for the inside will be referred to as K_I and that for the outside as K_o.

K_I can be derived by separating $\frac{Mc}{I}$ from $S = \frac{Mh_1}{Aea}$

and letting K_I denote the remaining terms. K_o is derived in the same manner from

$$S_o = \frac{Mh_2}{Aec}$$

+ + +

Development of K_I and K_o.

For the curved beam

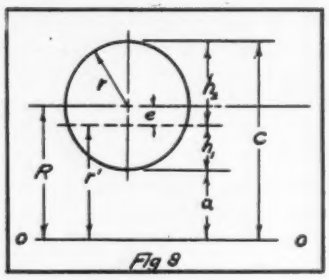


Fig 8

$S = \frac{Mh_1}{Aec}$, $I = \frac{\pi d^4}{64}$

and $A = \frac{\pi d^2}{4}$

SUBSTITUTING (r-e) for h_1 and (R-r) for a, we have

$$S = \frac{M(r-e)}{Ae(R-r)} = \frac{M(r-e)}{\frac{\pi d^2}{4} e(R-r)}$$

Now multiplying by $d^2/16/d^2/16$ we have

$$S = \frac{M}{\frac{\pi d^2}{4} \times \frac{d^2}{16}} \times \frac{(r-e)}{e(R-r)} \times \frac{d^2}{16} = \frac{M}{\frac{\pi d^4}{64}} \times \frac{(r-e)}{e(R-r)} \times \frac{d^2}{16}$$

$$= \frac{M}{I} \times \frac{(r-e)}{e(R-r)} \times \frac{d^2}{16}$$

Let $c = d/2$ as for c in Mc/I for the straight beam. Then dividing by $\frac{c}{d}{2}$

$$S = \frac{Mc}{I}\left[\frac{(r-e)\,d^2}{e(R-r)\,d/2 \times 16}\right] = \frac{Mc}{I}\left[\frac{(r-e)\,d}{8\,e(R-r)}\right]$$

Substituting d/2 for r, D/2 for R and simplifying

$$S = \frac{Mc}{I}\left[\frac{(d/2 - e)d}{8e\,(D/2 - d/2)}\right]$$

Dividing both upper and lower terms in the brackets by d

$$\left[\frac{\frac{(d/2 - e)d}{d}}{\frac{8\,e\,(D/2 - d/2)}{d}}\right] = \left[\frac{(d/2 - e)}{\frac{8e\,D}{2d} - \frac{8\,ed}{2d}}\right] = \left[\frac{(d/2 - e)}{4\,e(D/d - 1)}\right]$$

Now letting the ratio D/d, which will be referred to as the spring index, equal C we have as the final form for the curvature correction factor for the inside of the coil

$$K_I = \left[\frac{d/2 - e}{4\,e\,(C-1)}\right] \qquad (15)$$

Then

$$S = \frac{Mc}{I} = \frac{M}{\frac{\pi d^4}{64}} \times \frac{d}{2} = \frac{64\,M}{2\,\pi\,d^3} = \frac{10.2\,M}{d^3}$$

and our final equation for stress at the inside of the coil is

$$S = \frac{10.2\,M}{d^3}\left[\frac{d/2 - e}{4e\,(C-1)}\right] = \frac{10.2\,M}{d^3} K_I \qquad (16)$$

BY similar treatment of Eq. 11 we find that

$$K_o = \left[\frac{d/2 + e}{4\,e\,(C+1)}\right] \qquad (17)$$

and $$S_o = \frac{10.2\,M}{d^3}\left[\frac{d/2 + e}{4\,e\,(C+1)}\right] = \frac{10.2\,M}{d^3} K_o \qquad (18)$$

+ + +

BY calculating values of e from equation (12) and (13) the values of K_I and K_o may be obtained and plotted against the index. The resulting curves appear to be hyperbolic in nature and are shown in Fig. 10.

+ + +

FOR our deflection equation we will go back to Eq. 8 and solve for $\Delta d\theta$.

$$\frac{E\,\Delta d\theta}{d\theta} = \frac{M}{Ae} \qquad (8)$$

$$\Delta d\theta = \frac{M\,d\theta}{Ae\,E} = \frac{M\,ds}{RAe\,E}$$

Integrating between limits 0 to π D

$$\Delta\theta = \int_0^{\pi D} \frac{M ds}{RAe\,E} = \frac{\pi\,D\,M}{R\,A\,e\,E} \qquad (19)$$

for one coil or

$$\theta = \frac{\pi\,DNM}{RA\,e\,E} \qquad (20)$$

for N coils.

+ + +

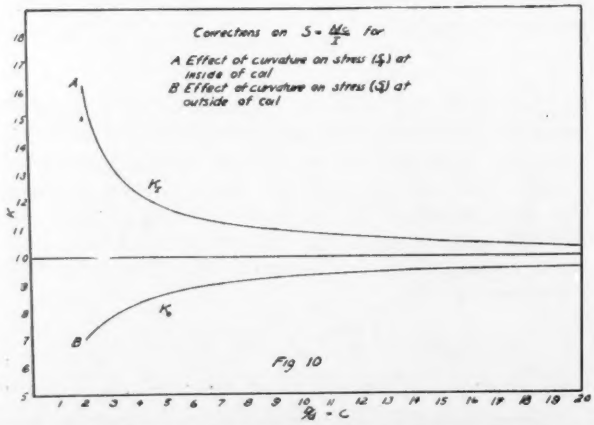
THIS is the exact equation taking into consideration the curvature of the coil. Returning for a moment to equations (4) and (5) we see that for large values of the index C or D/d y is negligible in comparison to r and the term (r-y) becomes equal to R. From equation (4) we see that the neutral axis must then coincide with the center of gravity of the cross section and Eq. 5 becomes

$$\int y\,dA = \frac{E\Delta d\theta}{d\theta}\int \frac{z^2\,dA}{r-y} = \frac{E\Delta d\theta}{d\theta}\int \frac{z^2\,dA}{R} = M$$

Upon integration this becomes

$$\frac{E\Delta d\theta}{d\theta} \times I/R = M$$

and solving for d θ we have


Corrections on $S = \frac{Mc}{I}$ for
A Effect of curvature on stress (S) at inside of coil
B Effect of curvature on stress (S) at outside of coil
A
B
K_I
K_o
K
C = D/d
Fig 10

$$\Delta d\theta = \frac{MRd\theta}{EI} = \frac{Mds}{EI} \qquad (21)$$

Integrating between limits 0 to π D

$$\Delta\theta = \frac{\pi DM}{EI} \qquad (22)$$

for one coil or

$$\theta = \frac{\pi DNM}{EI} \qquad (23)$$

Letting πDN equal l, the length of active wire in the spring results in the equation

$$\theta = \frac{M l}{EI} \qquad (24)$$

which is also the equation for the rotation of the tangent to the elastic curve of a straight beam loaded with a pure moment as shown in Fig. 11. By letting πDN equal l in Eq. 20 we obtain

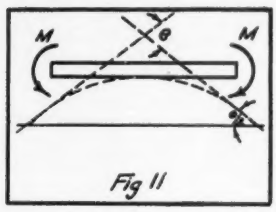


Fig 11

$$\theta = \frac{M l}{RA e E} \qquad (25)$$

+ + +

SINCE Eq. 25 is cumbersome to use due to the difficulty of calculating, it is desirable to have a correction factor K_c, of a form similar to the stress correction factors, which may be used in conjunction with Eq. 24.

+ + +

THIS equation would appear as

$$\theta = \frac{M l}{E I} \cdot K_c \qquad (26)$$

K_c may be found by dividing Eq. 25 by Eq. 24. If we denote θ calculated with the approximate equation as θ_a and θ as calculated with the exact equation as θ_c then

$$\frac{\theta_c}{\theta_a} = K_c = \frac{M}{RA e E} \times \frac{EI}{Ml}$$

$$K_c = \frac{I}{RAe} \qquad (27)$$

Substituting values of I and A for a circular cross section

$$K_c = \frac{\frac{\pi d^4}{64}}{\frac{R \pi d^2 e}{4}} = \frac{d^2}{16Re}$$

Changing R to D/2

$$K_c = \frac{2d^2}{16 e D} = \frac{d}{8 e C} \qquad (28)$$

and

$$\theta = \frac{M l}{EI} K_c \text{ or } \frac{Mld}{8EIeC} \qquad (29)$$

Putting $\frac{Ml}{EI}$ into a form convenient for calculating spring deflections,

$$l = \pi D N$$

$$I = \frac{\pi d^4}{64}$$

then

$$\theta = \frac{\pi DNM}{\frac{\pi d^4 E}{64}} K_c = \frac{64 DNM}{E d^4} K_c \qquad (30)$$

IN all of the above development θ is expressed as radians. However, in the actual design of springs θ is usually more conveniently expressed either as the number of turns of rotation N or as degrees.

$$n = \frac{\theta}{2\pi} = \frac{64DNM}{2\pi Ed^4} K_c$$

$$n = \frac{10.18\ DNM}{E d^4} K_c \qquad (31)$$

in which

n = number of turns of rotation
D = pitch diameter of the spring
N = number of active coils
M = applied moment
K_c = curvature correction factor
E = modulus of elasticity in tension
d = wire diameter.

and 360n gives the deflection in degrees. Eq. 31 then is an accurate equation for calculating deflection of a curved beam loaded with a pure moment.

+ + +

IT can be seen from Eq. 28 that K_c is a pure number, dependent only on the index C, since the ratio d/e is constant for a given index regardless of actual spring dimensions. We can therefore plot values for K_c against the index in the same manner as was done with the stress correction factors. These values of K_c were calculated and the resulting curve is shown in Fig. 12. For indices above 7, K_c becomes so small that further calculations are useless.

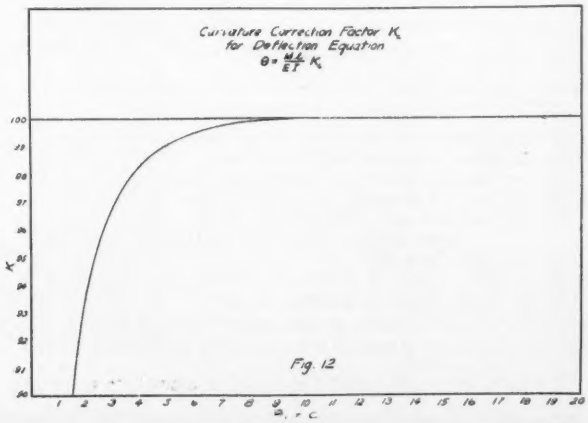
UPON studying this curve it should be evident that K_c may be safely neglected unless a spring is being designed for a very fine instrument. An index of 3 is about as low as is possible to manufacture, and for this index the error caused by the omission of K_c is about 3%. This amount of error is as low or lower than errors caused by variations of wire size, diameter, and number of active coils occurring during the manufacturing process.

+ + +

FOR practical use, then, we have shown that if our assumption of a constant moment is correct, Eq. 24 used as

$$n = \frac{10.18\ DNM}{E\ d^4} \qquad (32)$$

should be the best equation for calculating deflections in torsion springs.


Curvature Correction Factor K_c
for Deflection Equation
$\theta = \frac{Ml}{EI} K_c$
100
K_c
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
C
Fig. 12

HAVING developed the theoretical equations we may now proceed to correlate them with our experimental data.

✦ ✦ ✦

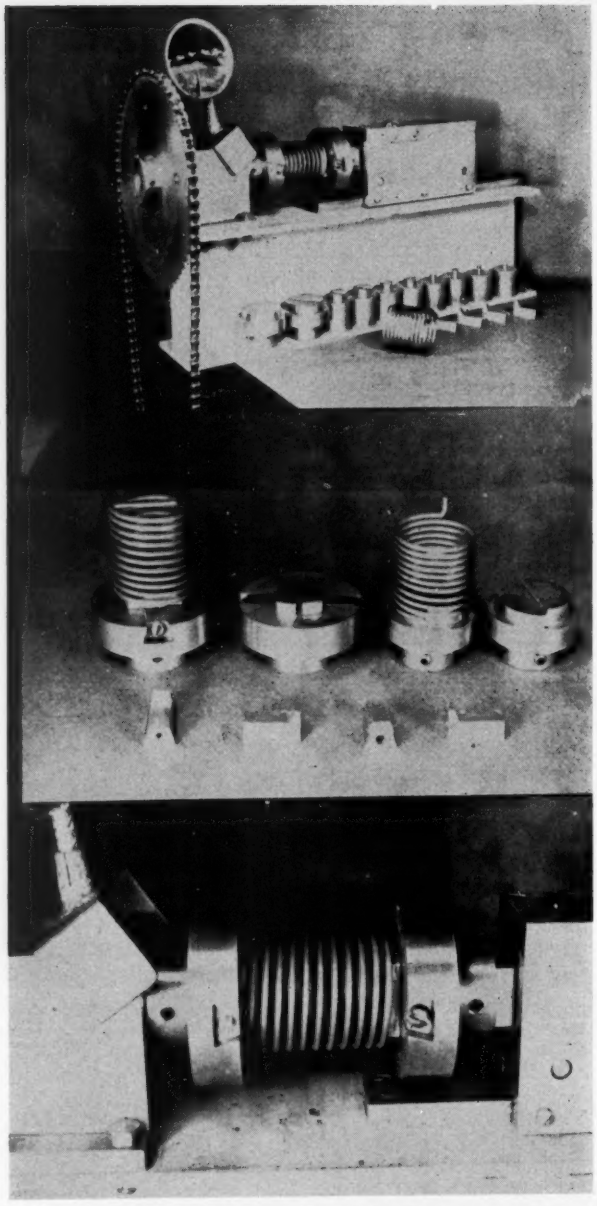
THE springs used were made of 1/8" wire in diameters of 2", 1", 3/4", 1/2" and 3/8". This gave indices of 16, 8, 6, 4 and 3. Torsion springs are usually close coiled but the experimental springs were made with a 1/4" pitch (1/8" between coils), just enough space to insure no friction between coils. For each index, springs of 8.5, 4.5, 2.5 and 1.5 active coils were tested, using 5 to 8 samples for each number of active coils. Materials tested were music wire and oil tempered wire. The first group of tests were run on springs as coiled, with no heat treatment. The second group repeated the same tests on music wire drawn at 400 deg. F., and 750 deg. F. after coiling, and an annealed wire quenched and drawn at 750 deg. F. after coiling.

✦ ✦ ✦

A MACHINE was designed and built for the test work since no suitable equipment existed. The springs were held as previously explained and these fixtures were mounted on shafts, one rotating, the other fixed. The rotating shaft was mounted in ball bearings and fitted with a large sprocket at one end, the other end receiving the various sized end fixtures for the different indices. A continuous chain was used on the sprocket so that weights could be conveniently hung on while the lever arm remained constant regardless of the amount of deflection. A 360 deg. protractor was mounted on the sprocket wheel and a pointer on the body of the machine, the protractor being large enough so that divisions of a tenth of a degree could be fairly well estimated.

✦ ✦ ✦

A TORSION spring increases in length when it is wound up. When this investigation was first started it was thought that constricting the spring so that it was not free to change length as it was wound up might produce torsional stresses large enough to measurably affect the deflection and calculated stress. In order to allow the spring to change length, the shaft carrying the stationary end fixture was mounted on ball bearings in such a manner that, while it could not rotate, it could slide freely parallel to the axis of the spring. Upon comparing tests with the end allowed to slide, against tests



with the end locked, so that the spring could not change in length, no measurable difference in deflection could be found. It can then be safely concluded that any torsional stress so induced is negligible.

Glossary of Symbols Used

- n = number of turns the spring is rotated
- D = pitch diameter of the spring
- N = number of coils of active wire in the spring
- M = applied moment in inch-pounds
- E = modulus of elasticity in tension (Value of 29,000,000 used in this paper)
- d = wire diameter
- S_I = fibre stress at inside of coil
- S_o = fibre stress at outside of coil
- c = distance from extreme outer fibres to neutral axis. (For straight beams of circular cross section $c = d/2$.)
- C = D/d and is called the index of curvature or spring index
- I = moment of inertia of the cross section (for circular cross section $= \frac{\pi d^4}{64}$)
- K_I = curvature correction factor for stress at inside of coil
- K_o = curvature correction factor for stress at outside of coil
- K = curvature correction factor for deflections
- e = distance of neutral axis from center of gravity of cross section
- θ = angle of rotation expressed in radians

Part II will be published in April, 1941, issue of Wire and Wire Products.

Keep Those Machines Running

By George S. May,
Chairman, Board of Trustees,
George S. May Business Foundation

A study of selective selling, plant maintenance and production control as factors in increased production prepared especially for WIRE & WIRE PRODUCTS by George S. May, engineer and chairman of the Board of Trustees of the George S. May Business Foundation—a non-profit research organization operated in the interests of private business enterprise ✦ ✦ ✦ ✦ ✦

The Foundation's findings are intended to serve not only as a direct aid to business men but as a constructive answer to the propaganda from sources opposed to the capitalistic and democratic system. ✦ ✦ ✦ ✦

This study of management problems in the wire industry is one of many such studies which the Foundation has undertaken in a variety of industrial fields. ✦ ✦

"THE boys just ain't selling much of that stuff these days —and anyway we got about all we can handle with this other stuff we're working on."

✦ ✦ ✦

THE speaker is the boss of a big wire drawing and fabricating plant, who was asked to explain the reason for idle machines. Nothing unusual about the explanation. You are apt to hear something similar most any day in most any American plant.

✦ ✦ ✦

THE real significance of the remark lies in the fact that exactly the same thing was said to a field investigator of the **George S. May Business Foundation** by the owner of a competing plant—but with reverse English.

✦ ✦ ✦

THE product which the first manufacturer wasn't selling was being turned out on night and day schedules in the rival plant, the owner of which had just committed himself to the purchase of additional equipment to handle the output. It developed also that the second manufacturer was getting rid of some of the machines which the first manufacturer was using overtime to make room for new equipment of a different type.

✦ ✦ ✦

THE second manufacturer explained the departing machines quite simply. He said:

"My men ain't selling much of that stuff anyway these days."

✦ ✦ ✦

THE foregoing leads us to the conclusion that human beings can be strangely inconsistent.

✦ ✦ ✦

AT the first sign of a business depression we blame our troubles on overproduction and begin to worry about excessive industrial capacity. Yet, the first thing that occurs to us when we get a glimpse of "prosperity around the corner" is industrial expansion to take care of the new business.

✦ ✦ ✦

MANAGEMENT seems never to concern itself sufficiently with that much misused but important word, "efficiency" as it applies to existing plant facilities.

GEORGE S. MAY
Chairman, Board of Trustees
George S. May Business Foundation

When they do think of it, it is generally in relation to the machines that are momentarily heavily loaded, and even then the fullest possibilities are seldom realized.

✦ ✦ ✦

TO an engineer to whom efficiency is something of a religion, it is shocking to contemplate the vast amount of idle and unused machine capacity in a country where every wheel must be kept turning if our tremendous defense effort is to be successful.

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THIS unused machine capacity is represented not only by down and idle time of machines but also, in many factories, by inefficient operation of machines in use. The wire working industry, in general, can claim no exception to this indictment. Individual machine activities in wire industry plants, measured in terms of actual production hours against available hours, was found to vary all the way from nothing to rare cases of one hundred per cent.

✦ ✦ ✦

THIS leads us to one clear conclusion:

Plant expansion should come only after the highest possible degree of production has been wrung from existing equipment.

✦ ✦ ✦

MAXIMUM plant activity depends, not only upon efficient machine operation and careful production planning, but it must find its real base in the long range planning and the day to day effort of the plant's sales department. Perhaps a little straight thinking will help us here.

✦ ✦ ✦

EVERYONE realizes that a piece of money, a coin or a bill, for instance, is not a thing of value in itself but merely a medium of exchange for service. Just so, the product of a plant is, to the manu-

facturer himself, merely a medium through which the activity of his men and his machines can be translated into income for the company and its employees. Once this is clearly seen we are ready to accept the conclusion that the sales effort should be carried on in terms of plant activity. The ideal situation would be where the sales department sold just those products necessary to keep every machine loaded and none over-loaded.

✦ ✦ ✦

FIRST of all, of course, manufacturing plants should be so equipped that individual equipment capacity would balance proportionately with the plant's potential market. But when this balance is once struck, it is up to the sales department to sell accordingly. This is not nearly so difficult as it may sound. But the truth is that in most cases no attempt at all is made to gear the selling effort to plant activity. A universal adoption of a selective selling plan which accurately expressed plant activity requirements in terms of product sales quotas would not only answer the boom time needs for greater production, but would result in lower prices through more economical operation. This, in turn, would broaden distribution by continually extending the market to lower income levels.

✦ ✦ ✦

I KNOW at least one sales manager who understands the importance of selective selling. As is often the case when something is well done, there was a selfish motive.

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IT seems that this particular sales manager wasn't credited with his commissions until the goods were shipped. Therefore, he explained that he saw no point in accumulating a backlog of sales on items that couldn't be turned out at once. He figured he would be money ahead in the long run if he could put the idle machines to work, instead. Here's the way he put it:

"Like a lot of other sales managers, I had been concentrating on the high commission lines until the machines couldn't keep up. I decided that a small commission on a lot of stuff that the plant could turn out jingled more in my pocket than a big potential commission on stuff we couldn't deliver."

✦ ✦ ✦

HERE'S how he works it. When a job is sent to the cost department for figures, he insists on a complete schedule of the job, showing the machines over which it is to run and the number of hours of machine time required. This interpretation of the job in terms of machine hours is then posted on a chart in his office. A glance at the chart shows him, at any given time, the accumulated hours of production that have been sold for each machine. Against this figure for each machine, he makes a periodic notation of the elapsed potential hours and the difference between the two shows him whether he has over or under sold the capacity of his available equipment. For instance, he has turned in an order on the first of the month for fifteen thousand square feet of fifteen and a half gauge, three-quarter inch regular

SKETCH No. 1

STANDARD No. 18
CHAIN LINK DEPARTMENT
PRODUCTION RATES FOR CHAIN LINK LOOMS

SQUARE FEET PER HOUR

Wire Gauge	Width of Fabric	¾" Mesh Mach. No.	1" Mesh Mach. No.	1½" Mesh Machine No.			2" Mesh Machine No.		1½" Selvage Fabric Mach. No.
		1-2-6	1-2-6	1-2-6	4	5	4	5	2
#15½	Up to 2'11"	125		475					425
	3'0" to 5'11"	150		525					450
	6'0" to 12'0"	200		575				540	495
#14	Up to 2'11"			475				455(x)	425
	3'0" to 5'11"			500				480(x)	450
	6'0" to 12'0"			550				530	495
#12	Up to 2'11"			425		325		440(x)	
	3'0" to 5'11"			450		400		470	
	6'0" to 12'0"			500		450		520	
#9	Up to 2'11"					250		430	
	3'0" to 5'11"					320		480	
	6'0" to 12'0"				185(x)	370		510	
#6	Up to 2'11"							375	
	3'0" to 5'11"							450	
	6'0" to 12'0"							500	

MACHINE SETUP CHANGE

Change Mesh only	.90 hrs. allowed
Change Wire Gauge only	.70 hrs. allowed
Change Width of Fabric only	.40 hrs. allowed
Change Barb to Knuckle, etc.	.30 hrs. allowed
TOTAL SETUP	2.30 hrs. allowed

mesh. He knows that the capacity of his machine is 150 square feet per hour. Consequently, he knows that he has sold one hundred hours of this machine's capacity. If the factory is working on an eight hour per day basis and ten days have passed since the order was turned in, he knows that eighty hours of this one hundred hours sold have elapsed. With only twenty hours of the sold capacity left, he knows that his machine will be idle within the next three days unless another order is turned in.

✦ ✦ ✦

IN this system, of course, he assumes that the plant will hold up its end so far as production is concerned and he doesn't attempt to unload the work according to actual production. Nevertheless, the system gives him a splendid check on his own performance in terms of machine hours.

✦ ✦ ✦

BALANCED sales, however, are not the sole answer to the plant activity problem. Plant production must be maintained in like manner or the effort to achieve balanced volume will go for nothing.

✦ ✦ ✦

THIS will require constant vigilance. Forces which creep in to upset our efforts toward perfection will include such things as power failures, breakdowns, changeovers, material shortages, labor shortages, tool shortages, and order shortages. These must be coped with constantly. You can come a lot nearer perfection than you think by merely trying.

✦ ✦ ✦

POWER failure at its source, accidental breakdowns and changeovers to meet occasional customer emergencies are opposing forces that we can do little about. Power failures and breakdowns, however, due to lack of preventative maintenance, changeovers made necessary by inadequate planning, material, labor and tool shortages resulting from lack of internal coordination and order shortages resulting from misapplied sales effort are all opposing forces that can be met and defeated.

✦ ✦ ✦

TOO many plants are permitted to limp along on temporary or poorly contrived facilities.

SKETCH No. 2

STANDARD No. 65
PLANT No. 1
WIRE MILL
PRODUCTION RATES FOR WIRE DRAWING ON BENCHES Nos. 1-4-5

150 lb. coil
Soft Wire

Rates given in pounds per hour of Finished Wire drawn from No. 5 G. Rod.

	NUMBER OF HOLES DRAWN					
Wire Gauge	**1st.**	**2nd.**	**3rd.**	**4th.**	**5th**	**6th**
5						
6	1800					
6½						
7	1750					
7½						
8	1700	1410				
8½						
9		1310				
9½		1250				
10		1190				
10½						
11			1030			
11½						
12			860			
12½				640		
13				620		
13½						
14				500	420	
14½					410	
15					380	
15½					320	
16					310	
16½						
17						225

SKETCH No. 3
MACHINE REPORT

DEPARTMENT ..... **DATE** ..... **A.M.** **P.M.**

Mach. No.	Running	Change Over	No Material	No Orders	No Operator	Repairs	Other Idle Time
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							

If operating show order number and hours in second colum n. Indicate any other condition by lost hours in proper column.

HAZARDOUS, temporary wiring will be permitted indefinitely. Motors of inadequate horse power will be hooked up for temporary use and then forgotten about. Make-shift repairs, temporary tools, unqualified labor will be assembled for an emergency and continued in use long after the emergency has passed.

✦ ✦ ✦

WE asked the factory manager of a plant having a high performance record for the secret of his success. Being a diplomat he replied that he thought that everyone in his organization deserved equal credit. Off the record, he figured that the maintenance department was primarily responsible for the job. He just never thought about lost time due to breakdowns any more because there were no breakdowns. By some uncanny means his machine shop boss (who was also his maintenance man) could always seem to tell in advance when something was going to need repair and he was either able to fix it in off hours or to have the repair parts ready so that no lost time was encountered.

✦ ✦ ✦

THE wizard who performed this miracle turned out to be a normal, shy fellow and unwilling to take credit for doing anything out of the ordinary. He was simply methodical. If he found it necessary to do a temporary job, he decided then and there how long it would be safe or economical to let it stand and set up a tickler card to call it to his attention at the proper time. His tickler system contained a record of every temporary setup in his plant, regardless of how minor. Wiring, buildings, floors, line shafts, motors, every piece of equipment, are all inspected at regular intervals according to a posted schedule. If trouble develops between inspections, the interval is shortened next time. Belts are checked for tautness, cleanliness, lacings and splicings. Troublesome belts are replaced by better quality or heavier duty ones. He insists on good machines and good mechanics in his shop and good material for his repair jobs. In the final analysis he had nothing on the ball but a good eye for quality, patience enough to write things down and a sense of personal responsibility for the smooth operation of his equipment.

✦ ✦ ✦

A PERIODIC, overall inspection of plant conditions by management is another aid to activity control.

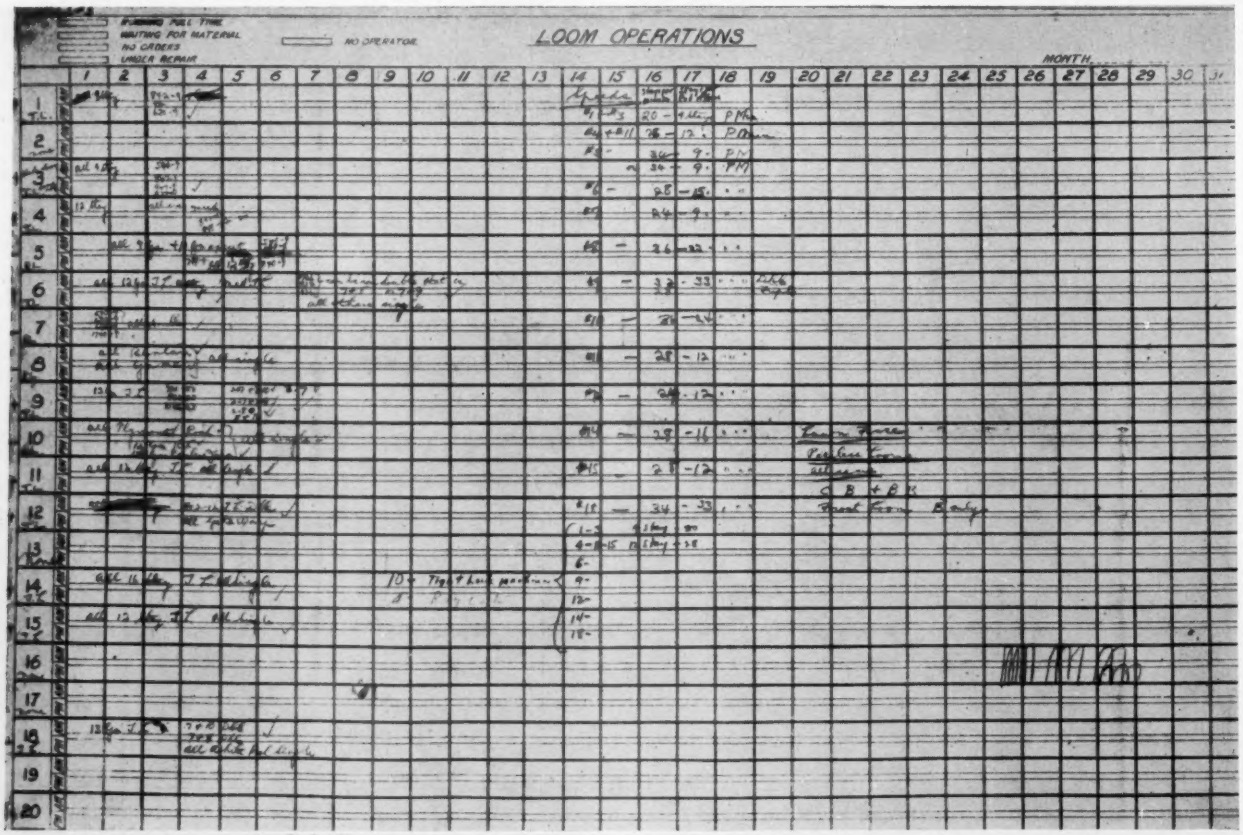
✦ ✦ ✦

WORN out and obsolete equipment is spotted and arrangements made for it to be disposed of or replaced. Needless to say machines incapable of competitive quality or low cost production have no place in modern enterprise. There just isn't enough slack in our price line for us to afford them.

✦ ✦ ✦

A WELL maintained plant, however, even with the aid of selective sales control and intelligent maintenance, does not guarantee efficient or uninterrupted

(*Please turn to Page 193*)



Bethlehem Doubles Rod Making Capacity At Sparrows Point

WITH the installation of a second group of finishing stands, and additional coiling, conveying, and storage facilities, the continuous high-speed rod mill at the Maryland Plant of Bethlehem Steel Company is now equipped for rolling four strands of rod at one time. The extension roughly doubles the rod making capacity of the mill, increasing it from 500 to approximately 1000 tons of No. 5 rod per 24 hrs.

✦ ✦ ✦

THE mill was built nearly three years ago and though at the outset it rolled only two strands of rods, it was designed for ultimate four-strand operation. A second rod finishing mill has been installed. Only minor alterations in the remainder of the equipment were required to complete the change over. The gas fired billet heating furnace was originally built for a rated hourly output of 50 gross tons which is sufficient for four strand production. As an extra precaution a few oil burners have been installed to insure the proper heating of the increased tonnage.

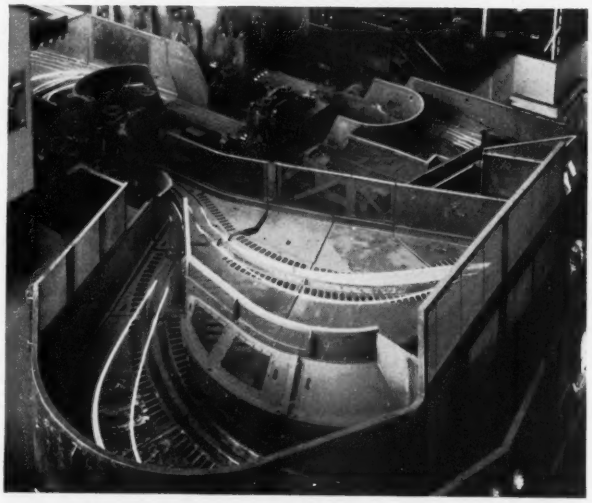


Fig. 1. No. 2 Rod Mill, Maryland Plant, Bethlehem Steel Company. Intermediate roughing stands and repeaters. ✦ ✦ ✦

✦ ✦ ✦

AT the discharge end of the heating furnace is a four strand mechanical switch plate, actuated by cylinders, which enters the heated billet selectively into the active passes of the first roughing stand. It is capable of maintaining operation without any intervals of inactivity in any of the passes.

✦ ✦ ✦

THE original mill consisted of a group of nine roughing stands, four intermediate roughers, two looping stands with repeaters, and a group of six finishing stands. To this has now been added another six-stand finishing train, substantially a duplicate of the first, except opposite in hand.

✦ ✦ ✦

FOUR-STRAND repeaters are used between the intermediate roughers and the first looping stand, and between the two looping stands. As two of the four strands leave the last looping stand they pass through a two-strand repeater of the forward running type to one of the finishing mills. To take care of the added finishing mill a new two-strand repeater has been super-imposed on the first. The upper repeater

(*Please turn to Page 199*)

Fig. 2. No. 2 Rod Mill, Maryland Plant. Roughing stands, four strand operation. ✦ ✦ ✦ ✦ ✦ ✦

Fig. 3. No. 2 Rod Mill, cooling bed and hook carriers. ✦ ✦

Outstanding Personalities of the Wire Industry

George N. Jeppson, President, Norton Company, Worcester, Mass.

THE election of **George N. Jeppson** as president of Norton Company, Worcester, Mass., succeeding **Aldus C. Higgins,** who resigned to become chairman of the board, was recently announced.

✦ ✦ ✦

MR. JEPPSON entered the employ of Norton Company in 1892. After being assistant superintendent and works manager, he was chosen a director in 1906. In 1919 he was made secretary, and in 1933 became treasurer. He has been a vice president for several years.

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American Steel & Wire Promotes Four Operating Men

THE promotions of four operating men have been announced by American Steel & Wire Co., subsidiary of the U. S. Steel Corporation. **A. F. White** has been appointed assistant to manager of operations of the Pittsburgh District. His position as general superintendent of the Donora, Pa., Steel & Wire Works has been assumed by **L. F. McGlincy** who formerly was division metallurgist in heating and hot rolling at the main office in Cleveland.

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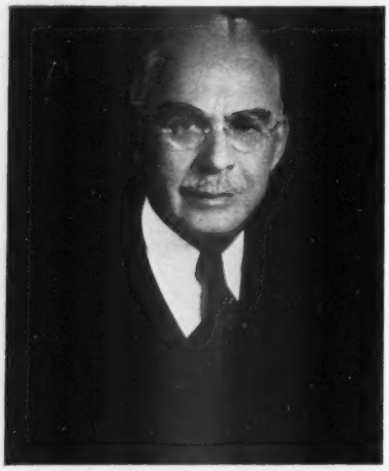
MR. McGLINCY'S position in Cleveland will be assumed by **Richard R. Snow,** at present assistant superintendent of open hearths and hot rolling at Worcester, Mass., and **U. F. Corsini,** assistant general foreman of the Worcester rod mills, will become assistant superintendent of open hearths.

✦ ✦ ✦

MR. WHITE spent thirty years at the Donora plant of American Steel and Wire. He was in the employ of Carnegie Steel and Illinois Steel Company, both subsidiaries of the U. S. Steel Corporation, until he joined American Steel & Wire as chief chemist at Donora Steel & Wire in 1910.



GEORGE N. JEPPSON
President
The Norton Company, Worcester, Mass.

MR. McGLINCY joined American Steel & Wire in 1924 in an industrial engineering capacity. He learned the business by working through the rolling mills and open hearths and became a superintendent in 1935.

✦ ✦ ✦

G. T. Avery, Works Manager, Acme Steel Company

THE promotion of **Guy T. Avery** as works manager of the Riverdale plant has been announced by the Acme Steel Company of Chicago. Mr. Avery has been with Acme Steel since February, 1920, when as assistant works manager he directed the processing of the company's general line items. He graduated from the University of Illinois, School of Engineering and served with the U. S. Navy as chief machinist's mate during the last war. His connection with a firm of consulting engineers preceded his association with Acme Steel Company.

✦ ✦ ✦

Heil & Company Announces New Appointments

HEIL & COMPANY of Cleveland, Ohio, have announced the appointment of district representatives to handle their special steam-air agitator jets for batch and continuous pickling.

L. W. Haag of Detroit, covering Michigan and Illinois.

Wm. M. Parkin Company, Pittsburgh—Pennsylvania and East.

Joseph Bean, Warren, Ohio — State of Ohio.

✦ ✦ ✦

THESE men will also sell the well-known Heil combination syphon over-flow for pickling tanks.

✦ ✦ ✦

J. Heber Parker Now President Carpenter Steel Company

THE election of **J. Heber Parker** as president of the Carpenter Steel Company has been announced. He succeeds the late Fred A. Bigelow who served as president since 1920. During his college vacations, Mr. Parker worked in the chemical laboratory of the company and upon graduation from Cornell University, entered the crucible department. He was named assistant superintendent in 1906; became chief metallurgist in 1910 and vice president in 1916. He is a member of the American Society for Metals, American Iron & Steel Institute, American Institute of Mining and Metallurgical Engineers and the Iron & Steel Institute of Great Britain.

✦ ✦ ✦

Robert Murray, Superintendent of New Haven Works of American Steel & Wire

THE American Steel & Wire Company, a subsidiary of the U. S. Steel Corp., has announced the appointment of **Robert Murray** as superintendent of the New Haven, Conn., works. Mr. Murray, who has been associated with American Steel & Wire since 1920, was previously assistant superintendent of the plant.

✦ ✦ ✦

Franklin E. Weaver Retires

AFTER more than 35 years' association with the American Brass Company, **Franklin E. Weaver,** director and vice-president has retired. **John A. Coe, Jr.,** vice-president in charge of sales, now has jurisdiction over all sales development, advertising and sales promotion activities of the company.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Dec. 1940 and Dec. 1939
(In Gross Tons)

	DEC. 1940	NOV. 1940	DEC. 1939
Wire rods	15,786	22,169	6,820
Strip steel	16,050	19,054	12,872
Plain, black or galvanized iron or steel wire	13,601	11,689	9,481
Barbed wire and woven wire fencing	5,654	4,491	7,413
Woven wire cloth	388	363	168
Wire rope	1,153	1,273	916
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	1,278	1,343	2,109
Wire nails	2,347	2,952	4,520
Tacks	194	65	117
Other nails, including staples	610	558	558
Bolts, machine screws, nuts, rivets, and washers	2,901	4,619	1,129
Total, these 11 classifications	59,962	68,576	46,103

Exports of Insulated Wire and Cable, December, 1940

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	629,493	$194,971	171,940	$ 36,898
Weatherproof wire	44,788	8,270	41,386	6,992
Other insulated copper wire	1,617,826	354,431	1,051,939	177,612
Nickel-chrome electric resistance wire	33,567	32,686	28	14
Total these 4 classifications	2,325,674	$590,358	1,265,293	$221,516

Iron and Steel Exports

UNITED States iron and steel exports in 1940, totaling 7,785,540 gross tons and valued at $476,351,104, were larger by nearly 25 percent than in any previous year.

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IN 1939 this trade had amounted to 2,499,002 tons valued at $180,995,835, while the tonnages exported in the record World War years of 1916, 1917, and 1918 had been 5,885,946, 6,268,546, and 5,370,265 tons, respectively.

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DECEMBER exports of 735,178 tons valued at $44,259,176 increased slightly over the November trade of 713,827 tons valued at $42,863,811, to end the 3-month long decline which had followed the peak August trade and compare with the 394,035-ton, $3,099,593 trade of December 1939.

✦ ✦ ✦

THE United Kingdom, with purchases totaling 362,366 tons, compared with 400,953 in November, was the leading market. Japan, whose purchases rose sharply from 9,401 tons in November to 85,752 in December, ranked second, followed by Canada, with purchases totaling 70,774 tons against 83,946 in the month. Other leading buyers were the Union of South Africa, 23,097 tons, and Brazil, 22,260.

✦ ✦ ✦

IN point of tonnage, non-alloy ingots totaling 240,095 tons was the leading commodity exported in December, and included 177,001 tons taken by the United Kingdom and 48,669 by Japan. Purchases made by these two countries also featured the 70,856-ton trade in pig iron; the United Kingdom taking 57,917 and Japan 4,764 tons. Other leading commodities in the December trade were non-alloy "other" plates, 64,517 tons; plain structural shapes, 40,423 tons; and non-alloy black steel sheets, 37,379 tons.

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THE United Kingdom was the leading foreign purchaser of American iron and steel during 1940, taking 3,487,781 tons, or 45 percent of the total to all countries. Other countries in this trade were Canada, with 885,050 tons; Japan, with 388,134 tons; Argentina, 362,059 tons; Brazil, 254,799 tons; and the Union of South Africa, 216,557 tons.

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Scrap Exports

EXPORTS of iron, steel and other scrap in December totaled 69,280 gross tons valued at $1,293,579 compared with 74,349 tons valued at $1,303,814 exported in November and 206,402 tons valued at $4,064,358 in December 1939.

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FIGURES for the respective calendar years 1939 and 1940 present a similar picture. In 1939 this trade had amounted to 3,577,427 tons valued at $55,810,417 whereas in 1940 the totals were 2,823,088 tons valued at $48,350,886.

✦ ✦ ✦

INCLUDED in the 69,980-ton scrap exports in December were 68,135 tons of iron and steel scrap, of which the United Kingdom took 55,290; Canada, 9,933; and Mexico, 2,522. All of the 670 tons of tinplate scrap exported went to Japan, but the 621 tons of tin-plate circles, and cobbles shipped in December reached a number of markets, including China, 440 tons, Egypt, 100, and Japan 52.

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EXPORTS of waste-waste tin amounting to 503 tons were distributed as follows: Hong Kong, 235; China, 183; and Thailand, 62. December exports of terneplate, totaling 51 tons, went entirely to China.

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Iron and Steel Imports

IRON and steel imports (not including scrap) amounted to 4,016 tons valued at $206,825 in December 1940—the highest since June of that year. This compared with the November trade of 728 tons valued at $165,009 — the smallest amount imported into the United States during any one month since 1918. In December 1939 imports of such products were recorded at 13,442 tons valued at $1,099,177.

✦ ✦ ✦

DECEMBER imports included 3,692 tons of spiegeleisen from Canada.

✦ ✦ ✦

DURING the whole of 1940 imports of iron and steel aggregated 55,277 tons valued at $6,097,266, which compared with 285,669 tons ($17,349,909) during the preceding year.

(*Please turn to Page 178*)

Exports and Imports of Wire

(*Continued from Page 177*)

CANADA continued as the chief source of supply with a total of 22,314 tons (against 52,904 in 1939); followed by Sweden, 12,910 tons (24,037); Norway, 8,846 tons (20,877); and British India, 6,826 tons (24,840).

✦ ✦ ✦

SCRAP imports in December dropped to only 48 tons valued at $624 from 252 tons valued at $3,519 in November. Mexico was the source of 39 and Denmark of 9 tons of scrap imported in December.

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ONLY 2,026 tons of scrap, valued at $48,291, was imported in 1940 against a total of 29,492 tons valued at $301,513 in the calendar year 1939.

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LEADING commodities in the 1940 trade in point of tonnage were spiegeleisen, 15,645 tons (against 38,562 in 1939); pig iron, 10,242 tons (38,592); and ferromanganese, 8,574 tons (33,415).

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Wood Screws

EXPORTS of iron and steel wood screws during November 1940, totaled 153,021 gross valued at $30,643. Of this total British India took 76,162 gross valued at $15,099; Philippine Islands, 13,821 gross valued at $2,152; Netherlands Indies, 11,208 gross valued at $2,481; Venezuela, 7,010 gross valued at $756; Cuba, 6,735 gross valued at $1,215; Guatemala, 5,638 gross valued at $922; Bolivia, 5,265 gross valued at $754; Canada, 4,380 gross valued at $661; United Kingdom, 3,855 gross valued at $1,928; Colombia, 3,284 gross valued at $578; Union of South Africa, 2,598 gross valued at $979; Costa Rica, 2,272 gross valued at $567; Peru, 1,444 gross valued at $280; Dominican Republic, 1,225 gross valued at $276; New Zealand, 1,127 gross valued at $288; and Iceland, 1,000 gross valued at $115.

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EXPORTS of brass wood screws during the same period totaled 17,757 gross valued at $8,033. Of this total Argentina took 3,950 gross valued at $699; British India, 2,916 gross valued at $1,562; British Malaya, 2,400 gross valued at $493; Panama Canal Zone, 2,357 gross valued at $1,263; Brazil, 1,547 gross valued at $240; Bolivia, 1,000 gross valued at $324; Netherlands Indies, 845 gross valued at $1,182; Union of South Africa, 599 gross valued at $892; Guatemala, 381 gross valued at $166; Canada, 309 gross valued at $429; Venezuela, 267 gross valued at $119; Mexico, 262 gross valued at $154; Costa Rica, 216 gross valued at $72; Netherlands West Indies, 148 gross valued at $94; Cuba, 125 gross valued at $78; and Honduras, 119 gross valued at $57.

✦ ✦ ✦

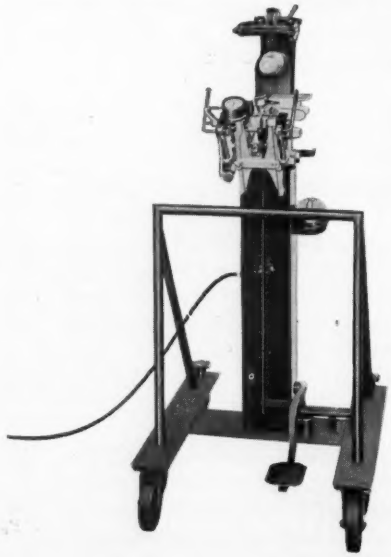
IMPORTS of wood screws during the same period were none.

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

CONTINUOUS IMPROVEMENT

MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone, State 7468

"Heavy" Products in Demand

THE so-called "light" steel products, such as wire, sheets, strip and tin plate, amounted to a smaller percentage of total output in 1940 than in any of the past eight years.

✦ ✦ ✦

DURING 1940, the "light" products together represented about 41½ per cent of the total tonnage produced for sale, while the "heavy" products such as semi-finished steel, plates, structural shapes, bars, rails, etc., represented 58½ per cent of the total.

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IN 1939 "light" products represented 45 per cent of the total, and in 1938, over 46 per cent of the steel shipped was in "light" product classifications. The sharp increase last year in the proportion of "heavy" steels reflects the greater demand for such products in connection with the program of national defense.

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Brazil

EXPORTS of Brazilian iron ore declined sharply in 1940. In the first 11 months of that year only 219,200 long tons were dispatched from Rio de Janeiro, against 363,656 tons in the comparable period of 1939. (Office of American Commercial Attaché, Rio de Janeiro.)

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Germany

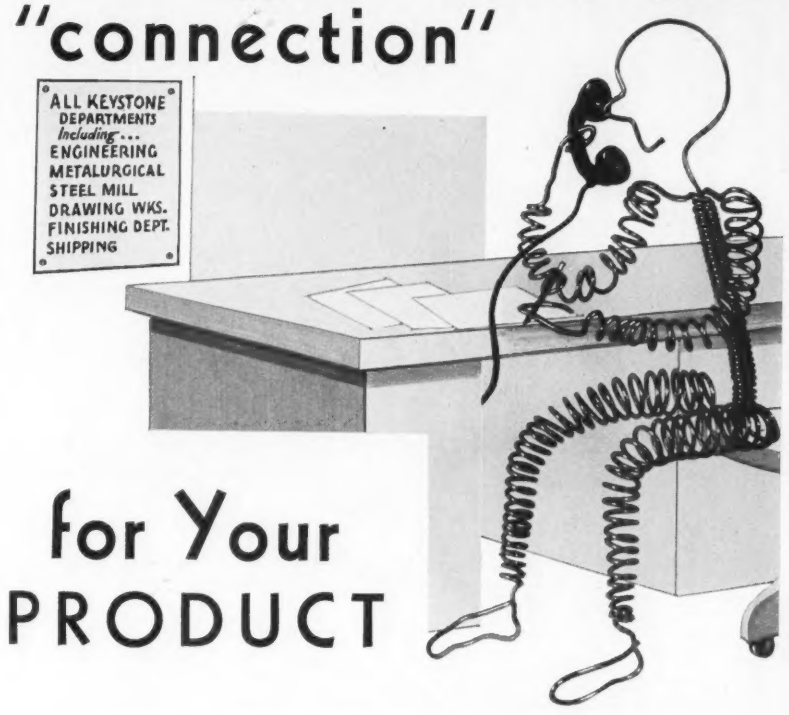
RECENTLY conducted research is reported to have demonstrated that Germany's losses of iron and steel as the result of corrosion are much smaller than had been popularly supposed. On the basis of these studies it is now estimated that Germany's losses of iron due to rust amount to only about 125,000 metric tons annually, or, roughly, one-half of 1 percent of current annual steel production.

✦ ✦ ✦

APPLYING the result of these studies to previously accepted estimates of world losses of iron and steel from corrosion—roughly

(*Please turn to Page 180*)

..a Good Wire "connection"



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Ever thought of teaming up your product with the long established reputation of Keystone Wire? It's like adding an important pedigree. Just mention "fabricated from Keystone-produced wire"—and they *know* that means "backed by the largest independent wire and fence mills in the world—52 years of wire-making experience." It's helped close many a big order.

Why not give us a call or ask for samples. No obligation—and well worth looking into.

KEYSTONE

STEEL & WIRE CO. Dept. W PEORIA, ILLINOIS

HIGH CARBON OR LOW CARBON

SAMSON SPRING WIRE

REG. U.S. PAT. OFF. KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

Bright-Tinned
Coppered
Annealed
Galvanized

The Modern Method That Utilizes

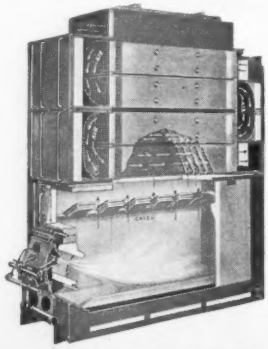
HIGH TEMPERATURE AIR

free from products of combustion

By circulating clean heated air free from products of combustion the Ross Wire and Rod Baker dries your product in much less time and entirely without the rusting often caused by other methods of baking. The lime coat with this improved type of air heating and circulation dries to a soft smoothness which prolongs the life of the drawing dies.

Ross Indirect Air Heaters are designed to supply heated air free from combustion gases. They are supplied for use with any gas or oil fuel available.

Whether your requirements are for a new baker or the revamping of your present unit, write us for particulars.



J. O. ROSS ENGINEERING CORPORATION

350 MADISON AVE., NEW YORK, N. Y.

CHICAGO, ILL. DETROIT, MICH. PITTSBURGH, PA.

ROSS ENGINEERING OF CANADA, LTD., Dominion Square Building, Montreal

Exports and Imports of Wire

(*Continued from Page 179*)

46,000,000 metric tons annually, with a total loss of some 718,000,000 tons between 1890 and 1923—it has been demonstrated that these figures exceed actual losses by 35 times.

✦ ✦ ✦

Mexico

THREE companies comprise the Mexican iron and steel industry—the Cia. Fundidora de Fierro y Acero de Monterrey, La Consolidada, and the Cia. Hierro y Acero de Mexico, S. A. The first, easily the largest, operates blast and open hearth furnaces, as well as rolling mills, and normally produces rails, structural steel, and a range of smaller products, including wire nails and bolts. At present, however, this company's 300-ton blast furnace is experiencing difficulties in obtaining sufficient coke, as its normal source, the plant of the American Smelting and Refining Co., at Nueva Rosita, Coahuila, is closed by strikes.

✦ ✦ ✦

LA CONSOLIDADA operates a steel furnace at Piedras Negras, Coahuila, and converts chiefly scrap obtained from Texas, with natural gas obtained from the same source. The resulting ingots are then shipped to Mexico City, where they are reheated and rolled into concrete reinforcing bars and small structural shapes. However, some of this material is further refined and, in the form of alloy steel, is used in the manufacture of automobile and truck springs.

✦ ✦ ✦

THE Cia. Hierro y Acera de Mexico, S. A., is engaged primarily in rerolling pieces of cut plates and similar material into concrete reinforcing bars and related products. Under the process employed, the scrap material, after being piled and pressed into bundles, is heated to welding temperature and then rolled. (Office of American Commercial Attaché, Mexico, D. F.)

✦ ✦ ✦

Turkey

DURING the first 8 months of 1940 Turkey produced only

87,734 tons of iron ore—less than one-half the 175,994 tons mined in the comparable period of 1939 and only about one-third of the 239,035 tons produced during the 1939 calendar year.

✦ ✦ ✦

Yugoslavia

THE Kranjska Industrijska Druzba, one of Yugoslavia's principal producers of iron products, has constructed a new furnace with an annual capacity of 20,000 metric tons. It was anticipated that this furnace would commence production in December 1940.

✦ ✦ ✦

Canada

THE Canadian Engineering Standards Association has been established as the national organization to provide specifications for the construction of electrical equipment to eliminate hazards to life and property, and has taken over the approvals laboratory of the Hydro Electric Power Commission of Ontario as a principal testing agency in this work. The association has issued an Approvals Manual (a copy of which is on file in the Electrical Division of the Bureau of Foreign and Domestic Commerce) which provides basic regulations and information regarding the approval of electrical equipment, outlines fees for the service, and specifies that electrical equipment which has been approved by a testing authority recognized by the Standards Association may be listed as approved, if it conforms to the established requirements. It is under this phase of the regulations that the Underwriters' Laboratories Incorporated, Chicago, participates in the approval of electrical equipment to be sold in Canada; ordinarily the test and approval is determined by the approvals laboratory at Toronto, heretofore operated by the Hydro Electric Power Commission of Ontario.

For Information
Regarding
The Wire Association
Address
Richard E. Brown, Secretary
300 Main Street, Stamford, Conn.

It's easier, works better when you get it *all* from one *maker!*

This is a suggestion to those contemplating installation of equipment for lead encasing cable:

Avoid installation delays, troubles in correlating work of hydraulic press, pump, accumulator and melting pot; have ALL items of equipment engineered by one maker!

This is a practice proved profitable by many of the industry's leaders. And, they most often have chosen ROBERTSON as their source for this equipment.

Detailed explanation of the operating advantages of a Robertson unit installation yours on request; absolutely no obligation. Write JOHN ROBERTSON CO., INC., 125-37 Water St., Brooklyn, N. Y.

ROBERTSON CABLE LEAD ENCASING EQUIPMENT

HYDRAULIC PRESS • HIGH PRESSURE HYDRAULIC PUMP • CLOSED LEAD MELTING POT

A Review of Recent Wire Patents

No. 2,227,442, APPARATUS FOR COILING HELICAL WIRE, patented January 7, 1941 by Floyd O. De Millar, Warwick, R. I., assignor to Elastic Knitted Wire Co. Inc., a corporation of Rhode Island.

This assembly includes a hollow, rotatable receptacle for storing the helical coil, the rotation of the receptacle being in timed relation to the helical coil formation, and a guide means for receiving the helical coil and feeding it circularly to the receptacle.

✦ ✦ ✦

No. 2,227,503, ELECTRIC CABLE, patented January 7, 1941 by Laszlo I. Komives, Detroit, Mich., assignor to The Detroit Edison Company, a corporation of New York.

Three multiple - strand conductors which, with their insulation, have an elliptical cross section, are enclosed in a lead sheath.

✦ ✦ ✦

No. 2,227,669, WOVEN WIRE FOR USE IN PAPERMAKERS' MACHINE OR APPARATUS, patented January 7, 1941 by Henry Hilton Parrett, Disley, England, assignor to C. H. Johnson and Sons Limited, Manchester, England, a British company.

The warp wires are of a copper-nickel alloy in the proportions of at least approximately 63 per cent of copper and approximately 37 per cent of nickel, the warp wires being drawn to the required gauge and annealed, whilst the weft wires are of relatively hard alloy of phosphor bronze.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

✦ ✦ ✦

No. 2,227,869, MANUFACTURE OF BARBED WIRE, patented January 7, 1941 by Hans Thiemer, Cologne-Mulheim, and Peter Hillesheim, Cologne-Holweide, Germany, assignors to Felten & Guilleaume Earlswerk Eisen and Stahl Actiengesellschaft, Cologne - Mulheim, Germany.

Wires, forming the barb carriers, are not drawn intermittently through the machine, but are fed at a constant speed and are arrested only momentarily in front of the barb twister at equal-intervals of time.

✦ ✦ ✦

No. 2,227,931, MAGNET WIRE, patented January 7, 1941 by John Whittier Greenleaf, Hamden, Conn., assignor to Rockbestos Products Corporation, a corporation of Massachusetts.

The wire conductor is insulated with a layer of glass yarn and a thin layer of felted asbestos over the yarn, with the asbestos fibers intermingled and having a reinforcing core of glass thread free of adhesive, and the asbestos slidable on the thread.

✦ ✦ ✦

No. 2,227,947, CLIP CRIMPING MACHINE, patented January 7, 1941 by Paul F. Schoen, Dearborn, Mich., assignor to Bohn Aluminum & Brass Corporation, Detroit, Mich., a corporation of Michigan.

This machine is adapted to crimp a clip-strip having a generally U-shaped cross-section.

✦ ✦ ✦

No. 2,228,390, WIRE STRAIGHTENER, patented January 14, 1941 by Richard D. Heller, Boise, Idaho.

The straightener comprises a number of sets of spaced apart guide rods, each set including three or more rods set at different diametrical positions, so that they form a tortuous path through which the wire can pass when bent.

✦ ✦ ✦

No. 2,228,441, CELLOPHANE COVERED STEEL WIRE, patented January 14, 1941 by Sol D. Cohen, New York, N. Y.

A Christmas tree ornament is provided, with the cellophane wrapping also protecting the wire from the corrosive action of fire-retarding chemicals with which the ornamental cellophane is impregnated.

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

HIGH SPEED TUBULAR STRANDING HEADS — TYPE "TH"

SIX SECOND STOPS

HEAVY BOX BASE

DOUBLE LATCHED STEEL BOAT CRADLES

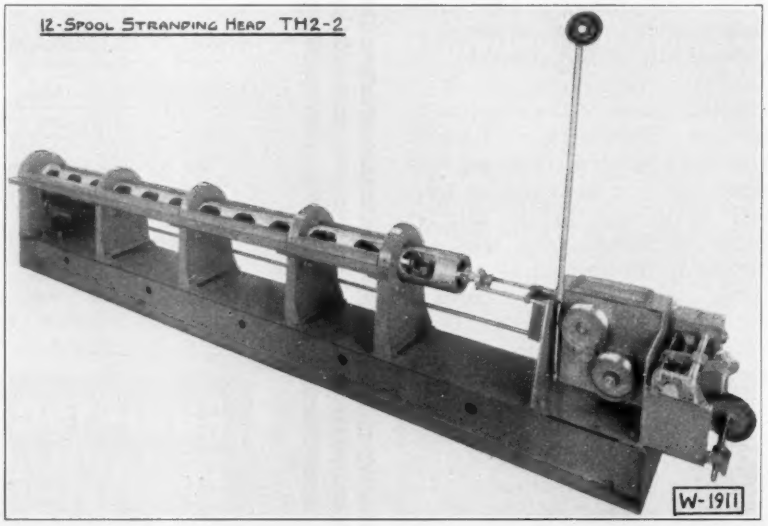
STEEL SPIDERS

ALL BALL BEARING

TUNGSTEN CARBIDE GUIDES

LOW WIRE ANGLES

DOUBLE GROOVED CAPSTANS



3" 4½" 8" 10" 12" 16" 22" 24" & 30" SPOOL SIZES

No. 2,228,748, COMBINED FEEDING AND COLD DRAWING MECHANISM FOR HEADING MACHINES AND THE LIKE, patented January 14, 1941 by Lee Berkebil, Detroit, Mich., assignor to B. W. Manufacturing Company, Detroit, Mich., a corporation of Michigan.

Reciprocating stock-gripping jaws are provided, which are released sufficiently during rearward movement to slide freely over the wire without moving the latter.

✦ ✦ ✦

No. 2,228,749, FEEDING AND COLD DRAWING MECHANISM, patented January 14, 1941 by Lee Berkebil, Detroit, Mich., assignor to B. W. Manufacturing Company, Detroit, Mich., a corporation of Michigan.

New means are provided for actuating the reciprocating jaws referred to above.

✦ ✦ ✦

No. 2,228,756, CABLE COATING MECHANISM, patented January 14, 1941 by Howard G. Donovan, Evanston, Ill., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

To each end of the hollow shaft of an electric motor, is attached a die, each of which, and the hollow shaft, being adapted to receive the coated wire.

✦ ✦ ✦

No. 2,228,766, APPARATUS FOR SATURATING THE FIBROUS COVERING OF WIRE, patented January 14, 1941 by Thor S. Johnson, Irvington, and John W. Olson, Hastings on Hudson, N. Y., assignors to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

A vacuum chamber is provided, having a seal for the conductor, comprising a rubber tubing which may be contracted by stretching.

✦ ✦ ✦

No. 2,229,423, ELECTROPLATING APPARATUS FOR WIRE OR THE LIKE, patented January 21, 1941 by Julian L. Schueler, Kokomo, and John L. Bray, West Lafayette, Ind., and Graydon E. Holdeman, Midland, Mich., assignors to Purdue Research Foundation, La Fayette, Ind., a corporation of Indiana.

More particularly, the invention lies in the provision of means for suspending and energizing the wires within the plating bath.

✦ ✦ ✦

No. 2,229,517, TWISTING OR STRAIGHTENING MECHANISM, patented January 21, 1941 by George E. Nighthart and Edward M. Wheeler, New Kensington, Pa., assignors to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania.

After being given their cross-sectional configuration by rolling, extrusion and the like, the warped, twisted or skewed bars, wires, etc., are straightened by this machine by applying a torsional force, sufficient to stress it beyond its elastic limit, at any desired point or points along its length.

✦ ✦ ✦

No. 2,229,662, APPARATUS FOR FORMING STRAND ASSEMBLIES, patented January 28, 1941 by Henry R. Massingham, Westfield, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

This assembly includes a twister for intertwisting the wire conductor strands in one direction, and separate means to knit successive covers on the twisted strands with the wales of one cover extending substantially in the same direction as the direction of twist of the strands and transverse to the direction of the wales of another cover.

✦ ✦ ✦

No. 2,229,787, HOLDER FOR COILS OF METAL WIRE OR STRAPPING, patented January 28, 1941 by Geoffrey Joseph Abbott, Carshalton, England, assignor to Packers Supply Company Limited, Surrey, England, a company of Great Britain.

A guide is provided, adapted to direct the wire from the coil in a direction at an angle to the plane of rotation of the coil carrier and outwards across the path of centering projections on the carrier.

No. 2,229,892, SELF - LOCKING SCREW, patented January 28, 1941 by Richard T. Hosking, Wilmette, Ill., assignor by mesne assignments, to Illinois Tool Works, Chicago, Ill., a corporation of Illinois.

Below the conical head is a depending lip, having a cutting edge projecting beyond the wall of the conical head and spaced therefrom by a pocket-like channel, the conical wall of the head being provided with a peripheral groove in alinement with the channel and communicating therewith, the effective depth of said groove being less than the depth of the channel and less than the inward projection of a wale formed by said lip in a work piece when said conical head is nearly seated in the work.

(Please turn to Page 184)

When you buy

SPOOLS and REELS

consider the advantages "American" offers

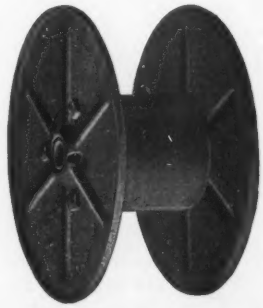
V The skill and experience to make them right

V The capacity to meet your needs

We have the tools, the dies, and all the modern equipment necessary to produce pressed-steel spools and reels skillfully, quickly, and economically.

Widely used in the wire industry for production operations and shipping, "American" Pressed-Steel Spools are light, clean, and sturdy. They will not break, chip, crack, or warp.

"American" Pressed-Steel Reels are equally indestructible. They meet every requirement of braiding, drawing, annealing, vulcanizing, and shipping.



The services of our Engineering Department are available, without obligation. Let us quote on your requirements.

The American Pulley Company, 4255 Wissahickon Avenue, Phila., Pa.

Special Representative
WALTER A. RICHARDS
20 N. Wacker Drive
Chicago, Ill.

AMERICAN
Pressed-Steel
SPOOLS AND REELS

A Review of Recent Wire Patents

(Continued from Page 183)

No. 2,229,967, METHOD OF MANUFACTURING ELECTRIC CABLE, patented January 28, 1941 by Edward S. Flynn, Hastings on Hudson, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

Oil-impregnated insulation of the cable is sheathed with a viscid bituminous thermoplastic material which is unsuitable for use during operation, subsequently applying a superimposed sheath characterized by its ability to withstand the electrical and mechanical stresses incident to operation, and finally dispersing said thermoplastic material through the oil-impregnated insulation by the heat released during operation of the cable.

✦ ✦ ✦

No. 2,230,109, SPRING ASSEMBLY AND SPRINGS THEREFOR, patented January 28, 1941 by William W. Gleason, Chicago, Ill., assignor to Nachman Springfilled Corporation, Chicago, Ill., a corporation of Illinois.

Coil springs for upholstery purposes are provided wherein the springs may rotate without danger of escape from the pockets of the top and bottom walls of the fabric.

✦ ✦ ✦

No. 2,230,110, SPRING KNOTTING AND SHAPING MACHINE, patented January 28, 1941 by William W. Gleason, Chicago, Ill., assignor to Nachman Springfilled Corporation, Chicago, Ill., a corporation of Illinois.

The knot retaining bends in the wire spring are formed prior to the beginning of and during the knotting operation.

✦ ✦ ✦

Spencer Wire Company Opens

THE opening of a new plant for the manufacture of high grade low carbon wire was recently announced by the Spencer Wire Company, Wire Village, Spencer, Mass.

✦ ✦ ✦

New Installation Announced By American Steel & Wire

INSTALLATION of equipment and alteration of existing facilities for the rolling of stainless steel and other special high quality rods is underway at the Collins Street plant, Joliet, Ill., by American Steel & Wire Co., subsidiary of U. S. Steel Corp.

✦ ✦ ✦

EQUIPMENT is being added to the present merchant rod mill at that plant which will allow the rolling of more highly specialized products. The installation includes five 10″ stands, two reels, a conveyor and two new billet heating furnaces, with provision for a third, besides the necessary handling, driving and control equipment. The new stands are added to the present two 18″ roughing stands and seven 12″ finishing stands.

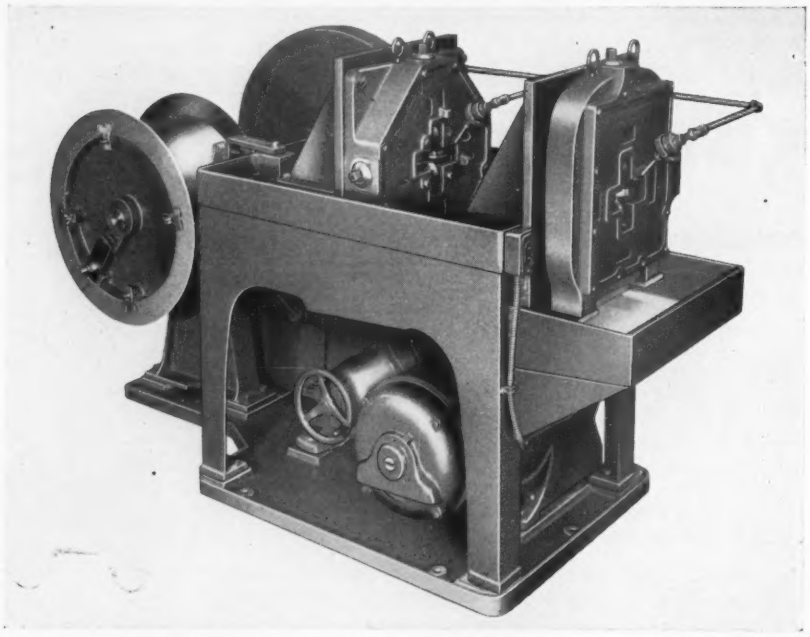
✦ ✦ ✦

A NEW building approximately 60′ square is being built to house the furnaces.

✦ ✦ ✦

Gages for Blind Workmen

GAGES which register readings by bell or buzzer signals have been developed at the Junkers Works at Dessau, to make possible the employment of blind persons in testing machinery parts. Inspection of parts having tolerances as small as 1/1000 of a millimeter is said to be possible with these gages, which are of either piston or membrane type, depending on the diameter of the parts to be tested. Mercury rising in capillary tubes, of which there are two, closes an electric circuit for either the reprocessing or the rejection signal. It is claimed that the workmanship of a piece can be judged by the pitch of the signal.



To speed up production of regular and irregular wire shapes use Standard Tandem Turks Heads

For example, at the Cleveland Metals Show the machine illustrated was in constant operation reducing .300″ round wire to $\frac{3}{16}$″ square with sharp corners and to exacting tolerance—in one operation at 140 feet per minute!

The Turks Heads can be either Universal or Plain Head types to produce rectangular, square, keystone, and irregular shapes.

Stands equipped with coolant circulating system are available for all sizes of Turks Heads.

Types range from variable speed drives to portable stands that are located in front of bull block.

Let us discuss possible applications of this machine to your work—address

★

Ask for catalogs showing Standard Swagers, Presses, Draw Benches, Rolling Mills, also.

IT'S STANDARD PRACTICE

MACHINERY COMPANY

PROVIDENCE, RHODE ISLAND

British Emergency Revisions Affect Steel Standards

WAR emergency revisions of several British standards for steel have been made due to the comparative scarcity of raw materials sufficiently low in sulphur and phosphorus for the production of steels to comply with normal British Standards.

✦ ✦ ✦

THE maximum percentage of sulphur and phosphorus permitted in the material in the following two standards has been increased in the emergency standards by 0.01 per cent:

Material Used in the Construction of Railway Rolling Stock (BS 24, Parts I and II, 1928).

Solid Rolled Steel Railway Wheels and Disc Wheel Centers (BS 468, 1932).

✦ ✦ ✦

INCREASED working stresses, effective for buildings erected during the period of the war and for 12 months thereafter, are provided in a war emergency revision to the British Standard for the Use of Structural Steel in Building (BS 449-1937). After the period named the specification is to revert to its original form unless in the meantime the revision has been confirmed or some other modification adopted.

✦ ✦ ✦

Computing Change Gears in Gear Hobbers Made Easy

A NEW 44-page booklet of special value to gear production men and engineers has just been published by Michigan Tool Company, Detroit. It presents in simple form short cuts of practical everyday assistance to those whose work involves the cutting and checking of gears.

✦ ✦ ✦

INCLUDED are Change-Gear formulae and tables for hobbing machines, formulae and tables for checking gears by the ball method and pin method, a table on hobbing speeds, complete tables of decimal equivalents of fractions for use with the change gear formulae, etc., as well as hob-checking equipment information, and formulae for calculating hobbing time.

TO make the book of most practical use, actual examples, applying the formulae are given in each case. With the new method of calculation evolved, set-up men should find it much easier than heretofore to perform all calculations required.

✦ ✦ ✦

A LIMITED number of the new booklets (Bulletin #270) are available for distribution.

✦ ✦ ✦

Chain Belt Conveyor Furnaces

THEIR Design, Construction and Application — a 12 page reprint of an article showing furnace details and containing over 30 illustrations of electric and fuel fired chain belt furnaces, including radiant tube and special atmosphere installations for the continuous heat treatment of miscellaneous small and medium sized parts and products. Just issued by The Electric Furnace Company, Salem, Ohio and available on request.

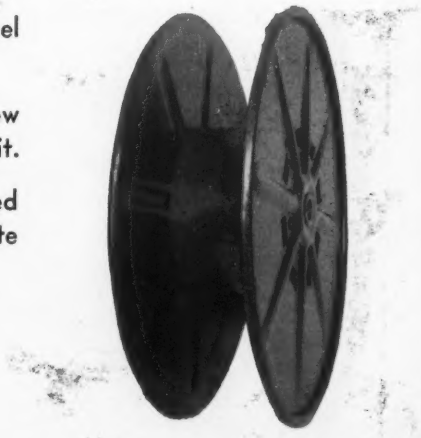
MOSSBERG **PRESSED STEEL** CORP.

Greater service from a new All Welded Steel Take Off Reel designed to meet present day requirements.

Usual maintenance expense eliminated by adoption of this new design wherein all parts are welded into one homogeneous unit.

Reel sides are embossed with radial reinforcing ribs for increased rigidity with rolled edges for additional strength and to facilitate handling.

Complete line of spools and reels for both processing and shipping all kinds of bare and insulated wires and cables. (Send for Catalogue W-104)



All Welded Steel
Take Off Reel

MOSSBERG
PRESSED STEEL CORP.
18 West Street
Attleboro, Massachusetts, U. S. A.

Ross Whitehead & Co., Ltd.,
Montreal & Toronto, Canada.

James Day (Machinery), Ltd., The Grange, Whetstone, Nr. Leicester, England.

International Electrotechnical Vocabulary

THE Argentine Electrotechnical Committee has notified the American Standards Association of completion of a Spanish version of the six-language International Electrotechnical Vocabulary so much in demand by manufacturers and purchasers of electrical equipment. This book contains a study of the scientific and industrial terms used in the various branches of electrotechnics. The Spanish version maintains the foreign idioms and numerical order exactly as in the original but instead of being in English and French, the definitions are now in Spanish.

✦ ✦ ✦

THE book is divided into a number of sections, the first of which covers fundamental and general definitions of electrical terms. The other sections deal specifically with: machines and transformers; switch gear and control gear; apparatus for scientific and industrial measurements; generation, transmission, distribution; electrical traction; power applications; thermic applications; lighting; electrochemistry; telegraphy, telephony; radiology; and electro-biology.

✦ ✦ ✦

THE definitions are given in Spanish only, but a translation of the terms alone is also given in German, Italian, French, English, and Esperanto.

✦ ✦ ✦

THE original book is the result of many years of continuous labor on the part of a committee of experts from Austria, France, Germany, Great Britain, Italy, the Netherlands, Poland, Spain, and the United States. The first printing was approved by the International Electrotechnical Commission at its meetings in Torquay in June, 1938.

✦ ✦ ✦

THE South American market is becoming more and more interested in standards as a basis of purchase, as evidenced by the organization of the new Brazilian standardizing body. The Argentine Electrotechnical Committee, translator of the Spanish edition, has been operating for some time.

✦ ✦ ✦

COPIES of the Spanish translation of the six-language International Electrotechnical Vocabulary (302 bound pages) may be obtained for $2.50 by writing to the American Standards Association, 29 West 39th Street, New York, N. Y. The ASA is serving as a clearing house for the Argentine Electrotechnical Committee in this matter, and consequently there will be some delay in the delivery of the books.

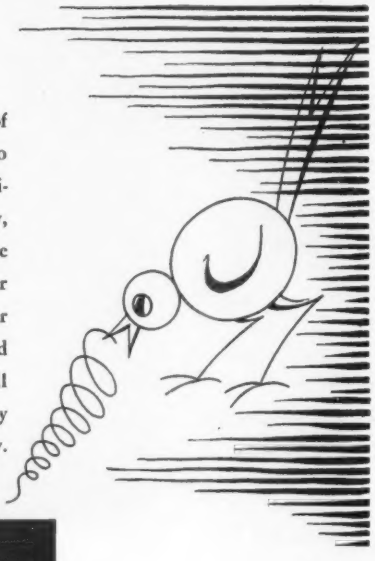
✦ ✦ ✦

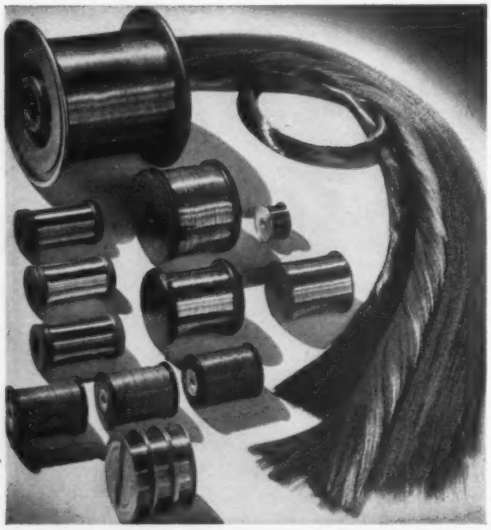
American Iron and Steel Institute Meeting to be Held May 22nd

THE 50th general meeting of the American Iron and Steel Institute will be held at the Waldorf-Astoria, New York City, on Thursday, May 22, 1941, according to an announcement by the Institute. Program of the meeting has not yet been announced. Attendance at all sessions of the meeting and at the banquet will again be restricted to individual members of the Institute.

"IN THE SPRING . . ."

they say, a man's fancy turns to thoughts of love—but practical minded industry turns to thoughts of dependable performance and uniform quality for its spring requirements. Today, when shut-downs can't be tolerated, Callite Wire, in many metals and special alloys, is your guarantee of quality on every count. If your requirements can't be met from stock sizes and materials on hand, Callite Metallurgists will produce a wire custom-made to meet any unusual requirements. Investigate today.





Write for

COMPLETE DETAILS

Callite wires are available in aluminum, steel, stainless steel, Everdur, brass—all grades, brush wire, commercial bronze, nickel-silver alloys and in combinations of these and other alloys. In round, flat and special shapes in sizes down to .002".

CALLITE WIRES

CALLITE TUNGSTEN CORPORATION

572-39th STREET · UNION CITY, NEW JERSEY

Branch Offices: Chicago, Ill. · Cleveland, O.

A WIRE FOR EVERY NEED — CALLITE TUNGSTEN — CT

Spring Coiling Machine Catalogue Issued By Torrington

THE Torrington Manufacturing Company of Torrington, Conn., has recently issued a new spring coiling machine catalogue. This is the first publication of this kind by the Torrington Manufacturing Company and it is quite interesting to know that in addition to descriptions of the machines produced by this company, complete specifications and technical data are furnished in connection with each individual machine description.

✦ ✦ ✦

A COPY of the catalogue may be obtained upon request from the Torrington Manufacturing Company, Torrington, Connecticut, U. S. A.

✦ ✦ ✦

Moisture Detector

MOISTURE is a common ingredient or adulterant in most materials. Until quite recently the only method available for determining it was to sample, weigh, dry, weigh and calculate the amount of moisture present. The time and effort necessary to do this generally made it a tedious and expensive method.

✦ ✦ ✦

MANY short cuts to determine moisture content have been suggested and tried throughout the years and just recently one of these has been perfected and is now being widely applied.

✦ ✦ ✦

IT has been found that the electrical resistance of many materials is a function of the moisture content, and the resistance varies as the moisture content varies. So with the development of vacuum tube circuits, it has been possible to apply this new technique in measuring electrical resistance and thereby the amount of moisture present.

✦ ✦ ✦

BASED on this principle the Colloid Equipment Company has made available a line of instruments known as the Delmhorst Moisture Detectors. These devices will give instantaneous readings indicating moisture content of from 8% to 24% for both surface and sub-surface condition. The electrodes penetrating the surface do not deface it.

✦ ✦ ✦

THE instrument is portable, rugged and compact, measuring 3½" x 5" x 7" in size and weighing about four pounds, and has a wide range of applications, among which are moisture content in insulation. Any of our readers interested in the device may secure more detailed information by addressing the Editor of WIRE & WIRE PRODUCTS.

FARREL NI-HARD ROLLS

Produce Higher Finish Sheets of Uniform Top Quality

Farrel Ni-Hard Rolls have been developed to meet the demand for high finish rolled sheets, free of tail marks and other imperfections. These alloy rolls combine extreme hardness with high strength and flawless surface. They last longer and reduce the cost per ton of output.

Farrel Ni-Hard Rolls offer the following advantages over high carbon, plain chilled and other types of alloy rolls:

1. **Complete freedom from pinholes or "orange peel" surface, assuring the production of sheets of uniform top quality and higher finish.**
2. **High strength, permitting heavier passes.**
3. **The strength and extreme hardness of Ni-Hard Rolls protect against breakage and deterioration of roll surfaces.**
4. **Less scouring and grinding than any other type of cast roll and longer useful life effect economies in maintenance and in cost per unit of output.**

Farrel Ni-Hard Rolls are used by representative plants in the rolling mill industries. Details of application to individual conditions and probable performance will be furnished on request.

Farrel-Birmingham Rolling Mill Equipment includes: Rolls—Rolling Mills—Rod Mill Tables and Manipulating Equipment—Universal Mill Spindles—Rod Coilers—Lead Presses for Pipe or Rod—Roll Grinding Machines—Roll Calipers—Gears—Mill Pinions—Pinion Stands—Gear Drives of any capacity—Flexible Couplings.

FARREL

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.

New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

George Richards Lamb, Former Director, Waterbury Farrel Foundry and Machine Company

GEORGE RICHARDS LAMB, retired Director and District Sales Manager of the Waterbury Farrel Foundry and Machine Company, Waterbury, Connecticut, died January 19 in Thomasville, Georgia, following a short illness. He and his wife, Ella (Lane) Lamb, who survives him, had planned to sojourn in the South throughout the winter.

✦ ✦ ✦

MR. LAMB was the son of George B. and Harriet (Welton) Lamb and was born in Waterbury, February 11, 1875. For 40 years he had been associated with the Waterbury company, of which his father was the first superintendent and later Vice President and General Manager, and for thirty-five years had been in charge of the district office in Cleveland, Ohio.

Milling Cutter Grinding Manual Issued By Carboloy

A COMPLETE shop manual on grinding practice in connection with cemented carbide type face mills and end-cutting tools has just been completed by Carboloy Co., Inc., Detroit, and is available for distribution.

✦ ✦ ✦

REPRESENTING the findings of several years of extensive field as well as laboratory research on cemented carbide milling cutter grinding practice in relation to cutter performance, the manual offers for the first time a complete and detailed guide to maintenance of such tools.

✦ ✦ ✦

THE booklet (Carboloy Bulletin #GT-127) comprises some 20 pages, and is accompanied by two 21 in. by 15½ in. charts illustrating the complete grinding procedure. It covers every variable involved, from selection of grinding wheel type, shape, and speed, to recommended tooth profiles for different purposes and different forms of milling cutters and end-cutting tools.

✦ ✦ ✦

THE manual takes into account the various types of tool grinders on the market, illustrating the method to be pursued on each type to obtain the best performance with the various cutters.

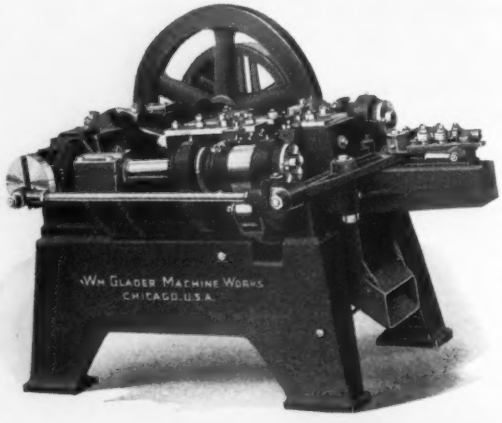
✦ ✦ ✦

IN view of the tremendous increase in recent months of carbide cutting tools to increase machine productivity, and the difficulties of imparting widespread information on grinding practice by direct instruction, the booklet has been so designed that by following it closely, the tool grinder completely inexperienced on cemented carbide tools can acquire all essential information for grinding carbide milling cutters.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues are $10.00

HIGH SPEED WIRE NAIL MACHINE



WM. GLADER MACHINE WORKS

210 N. Racine Ave. Chicago, Illinois

Glader Machines on large head, single-blow roofing nails can be seen in operation at any of the independent wire mills in the United States.

The production figures on common nails shown below, are guaranteed.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF WIRE	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00A	#16	1⅛"	700	37.2
#00	#14	1¼"	550	55
#0	#12	1¾"	450	89
#1	#10	2½"	400	192
#2	#8	3½"	325	310
#3	#4	5"	225	523
#4	#1	7"	190	622
#4s	5/16"	9"	175	1155
#5	⅜"	12"	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

American Standards Association Announces Quick Action Method For National Defense Standards

THE American Standards Association today announced adoption of a special method for quick action in developing Emergency Standards needed for defense purposes. This method will make it possible to turn out standards for parts and materials used in defense production as rapidly as is consistent with a good technical job.

✦ ✦ ✦

IN the words of the committee drawing up this streamlined procedure, "It is highly desirable that the American Standards Association be prepared to act promptly on requests for the preparation of standards for use in the National Defense Program. In order that such requests can be met with the speed that is essential, it is obviously necessary to greatly abbreviate the normal procedure of the Association."

✦ ✦ ✦

THE Emergency Procedure will empower special committees to act for the Association in starting new work, appointing Technical Committees, and in approving Emergency Standards.

✦ ✦ ✦

THE role that industrial standards play in peacetime production is greatly increased in time of national emergency like the present. This is because standards are a key factor in every program of large-scale production. Every government order is based upon specifications or standards; and as single order frequently extends to hundreds of companies—manufacturers of parts and suppliers of materials—each company must control its operations closely so that the completed product will comply with the standards originally laid down in the order. Shortcomings in the original standards—obsolete requirements—unnecessarily close fits—faults in workmanship or materials—or difficulties in the way in which the standards are applied by the manufacturer, all result in bottlenecks which cut down the flow of aircraft, blankets, trucks, etc., from the factories.

✦ ✦ ✦

ALL Emergency Standards will be published in a distinctive format that cannot be confused with regular American standards. After the emergency has passed, the newly adopted procedure provides that "the Defense Emergency Standards will be reviewed by the appropriate committees, and approved, amended, or withdrawn, through the regular procedures of the Association."

THE British Standards Institution and the Standards Association of Australia have for some time both been issuing Defense Emergency Standards developed under a similar relatively rapid procedure; and such standards have been exceedingly valuable to the governments and the industries of those countries in connection with their emergency war procurements. An interesting example of this work is the part the British Standards Institution

(*Please turn to Page 190*)

BIGGER LOADS *with* LESS REHANDLING

With a Cleveland Tramrail overhead materials handling system more bundles can be handled per load and rehandling greatly reduced.

In many mills, rod is taken from the cleaning house through coating and bakers to wire blocks without removing from the Cleveland Tramrail hairpin hook carriers.

Let Cleveland Tramrail help you reduce costs.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1141 East 23rd Street Wickliffe, Ohio

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT
Other products: CLEVELAND CRANES and STEELWELD MACHINERY

American Defense Standards

(*Continued from Page 189*)

has played in estimating tinplate requirements. Each section of industry was asked to standardize its requirements for tin cans in order to effect economies in the use of steel and so release material essential for armament purposes. It is estimated that as a result of the standardization work a saving of between 40,000 and 50,000 tons of tinplate a year will be effected. In another case standardization of steel requirements will, it is estimated, save Britain 60,000 tons of steel a year. The British Standards Institution has carried through a number of special defense jobs for its government, among them specifications for air-raid shelters and methods of securing effective blackout at entrances to buildings.

✦ ✦ ✦

AMONG the defense jobs on which the American Standards Association is already working are: Tool Steels, Screw Threads, Bolts and Nuts and Wrench Head Openings, Machine Pins, Wire and Sheet Metal Gages, Mechanical Fits, Statistical Methods of Quality Control in Mass Production. Many of its safety code projects are also important in providing protection for workmen on defense production jobs.

✦ ✦ ✦

Office of Small Business Activities Decentralized

TRANSFER and expansion of the Office of Small Business Activities and the addition of personnel to its 36 field offices was recently announced by the Office of Production Management. Hereafter the unit will be known as the Defense Contract Service.

✦ ✦ ✦

THE Federal Reserve System, under the direction of Governor Ernest G. Draper, member of the Board of Governors, will provide the nucleus of personnel for regional offices. Senior officers in each of the 12 Federal Reserve banks and their 24 branches have been serving as field agents for the Office of Small Business Activities and will continue this function under the new organization.

THESE field offices will be expanded and adequately staffed with business, financial, contract, and engineering experts to provide decentralized advisory services to all business enterprises, particularly smaller units, holding or seeking defense contracts or eligible for subcontracting work. Thus, all owners of manufacturing facilities, however large or small, will be able to find in their own geographic regions complete information and advice on all problems pertaining to the defense program.

✦ ✦ ✦

IT is contemplated that each field office will have several full-time experts and other part-time advisers on technical problems.

✦ ✦ ✦

ONE unit of the Defense Contract Service will give special attention to the question of broadening the subcontracting system and attendant problems.

✦ ✦ ✦

THE defense program having created a shortage in copper,

The Pittsburgh Regional Meeting of the Wire Association

WILL BE HELD AT

Pittsburgh, Pa., Thursday, April 17, 1941

Advance Information May Be Secured

By Addressing

DR. S. A. BRALEY, CHIEF METALLURGICAL FIELD ENGINEER

PITTSBURGH STEEL COMPANY

PITTSBURGH, PA.

CHAIRMAN OF COMMITTEE

✦ ✦ ✦

Full Details Will Appear in the April Issue of Wire & Wire Products

the Metals Reserve Co. will make available to the market generally all or such part of 100,000 tons of Latin American copper heretofore purchased as may be necessary to meet manufacturing requirements. This copper will be made available to the extent that the domestic supply is insufficient to meet the present demand and at the present market price of 12 cents per pound.

✦ ✦ ✦

Chemical Analysts Needed for Government Work

AN examination to fill chemical analyst positions has recently been announced by the United States Civil Service Commission. The position of senior chemical analyst pays $2,000 a year, that of assistant chemical analyst, $1,620 a year, less a retirement deduction of 3½ percent. Applicants are desired who are skilled in the standard methods of analysis used in commercial laboratories. Applications must be on file at the Commission's Washington office not later than March 13 and March 17, 1941, the extra time being allowed for those sent from States east of Colorado.

✦ ✦ ✦

THERE are five optional subjects in which an applicant may qualify: Precious metals assaying, ore and metals analysis, coal analysis, petroleum analysis, and gas analysis. The duties include making chemical analyses or assays, collecting samples of materials, and making computations to determine the results of analyses. Applicants must have had experience in analytical chemical work, including some experience in the optional subject selected. Appropriate college study may be substituted for part of this experience.

✦ ✦ ✦

FURTHER information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

Shortage of Iron and Steel in New Zealand

ACUTE shortage of many types of iron and steel in the face of strong demand characterized the New Zealand market in July. The supply of pig iron, although still inadequate, has improved with resumption of shipments from Australia. Even so, there have been proposals to reopen the Onekaka works for the production of pig iron, but the American Consulate General at Wellington reports that for the time being, at least, this will not be done.

This is an invitation for you to become a member of The Wire Association.
The Annual Dues Are $10.00

Ajax Electric Appoints New Representative

THE Ajax Electric Company of Philadelphia, Pa., has announced the appointment of **Fairman B. Lee** of 166 Jackson Street, Seattle, Washington, as representative for their company in the territory of Washington, Oregon, Northern Idaho and Western Montana.

UP GOES EFFICIENCY
ALL DOWN THE LINE

WITH TECO CARBIDE WIRE DRAWING DIES

Better production at lower cost — that's the big feature of TECO Carbide wire drawing dies. Designed to draw finer finished wire, Teco's unusually smooth, even, and dependable wire drawing performance cuts down interruptions, wire rejections and die replacements, increasing efficiency all down the line. Take advantage of the superior performance and definite economy of longer lasting Teco dies. Low carbide prices mean extra savings. A Tungsten Electric engineer will be glad to discuss your wire drawing problems with you. Consult us today. Get the complete, cost-cutting story on Teco Carbide Dies.

Pioneers in Tungsten Carbide for over a Quarter of a Century

NEVER SAY DIE ... *always specify*
TECO CARBIDE DIES
for smooth wire drawing ... THEY LAST LONGER

Tungsten Electric supplies carbide blanks, tools, bits. Wire and bar dies, tubing, extruding and sizing dies. Also, special tools, such as spot facers, reamers, broaches, form tools, etc.

TUNGSTEN ELECTRIC CORPORATION
564 - 39th ST. • UNION CITY, N. J.
Branch Office: 2900 Euclid Ave., Cleveland, O.

For BETTER WIRE

Copper-coat with CUPRODINE

CUPRODINE creates a denser, tighter, brighter and more uniform coating, in less time. Provides better lubrication for drawing than ordinary copper coating.

Pickle with RODINE

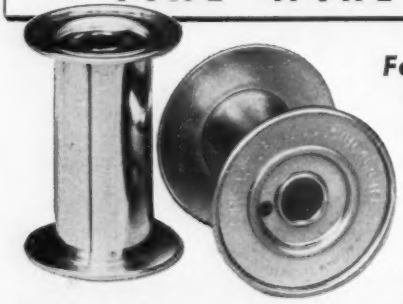
CHEMICALS ACP PROCESSES

RODINE, added to the pickling bath, saves acid and metal, minimizes brittleness, and lowers pickling costs. Standard the world around.

For complete information write

AMERICAN CHEMICAL PAINT CO.
Main Office & Works AMBLER, PENNA.

ALL-METAL FINE WIRE SPOOLS



For Winding and Shipping Fine Steel, Copper, and Enameled Wires

★

Non-Snag winding, light weight, safe and convenient shipping of your fine wires—these are advantages of using an All-Metal Clark Spool. The reasons for these advantages are to be found in the design, construction, and materials used in the spool:

Metals tested for maximum rigidity.

Locked-seam barrel and one-piece ends, permanently and smoothly assembled —no chance of trapping wire at the joint.

Full curl on ends—no rough edges.

Identifying copy embossed in ends.

Finish—gold or copper lacquer, or a variety of colored lacquers.

Spool sizes: 2-7/16″ or 3″ diameter ends; 2-7/16″ size made with 1½″ diameter barrel only, the 3″ diameter with 1½″ or 1¾″ diameter barrel; length of barrel to suit your winding needs.

We will send samples at your request.

J. L. CLARK MANUFACTURING CO.
600 23rd AVENUE • ROCKFORD, ILLINOIS

Production of Finished Steel Reaches New Peak in 1940

THE American Iron & Steel Institute, in the February, 1941, issue of "STEEL FACTS", reports that the total production for sale of 48,585,000 net tons of semi-finished steel products in 1940 exceeded by a substantial margin the tonnage produced in any earlier year.

✦ ✦ ✦

THE tonnage produced for sale last year exceeded the total in 1939 by 25 per cent, and likewise was ahead of the 1929 output. No production figures exactly comparable with those covering production for sale in 1940, however, are available for 1929.

✦ ✦ ✦

Frederick Hollister

CLIFFORD FREDERICK HOLLISTER, 60, vice-president and treasurer of the American Brass Company died suddenly January 11, 1941, at his home in Waterbury, Conn.

✦ ✦ ✦

MR. HOLLISTER was born in New Haven, April 15, 1880. He entered the employ of the former Coe Brass Company in Torrington in 1902. The company later became the Torrington division of the American Brass Company. Mr. Hollister was elected treasurer of the American Brass Company in 1916 and his election to vice-president came in 1928.

✦ ✦ ✦

W. I. Sivitz Dies

WILLIAM I. SIVITZ, Manager of the Pittsburgh Office of The Duriron Company of Dayton, Ohio, died suddenly January 30, in Pittsburgh. He had been with the Company since 1929. Before that, he was with the Aluminum Corporation of America. Mr. Sivitz was the newly elected president of the Pittsburgh chapter of the American Institute of Chemical Engineers and was a graduate of Carnegie Institute of Technology.

Keep Those Machines Running

(*Continued from Page 174*)

performance. The additional necessary factor is production control. That is, the machines must be properly loaded with products and the flow of production must be properly engineered and maintained.

✦ ✦ ✦

ANY effective production control plan that is to result in proper activity control (i.e. full utilization of machine facilities) must be founded upon a precise understanding of machine or production center capacity in terms of unit product.

✦ ✦ ✦

AN understanding of this kind can only be gained through a detailed analysis of the operation of every piece of equipment. Such an analysis requires time studies and experimental tests to determine actual running time and also time studies and tests on unavoidable down time for setups, adjustments and reconditioning of machine tools, bits and parts.

✦ ✦ ✦

FROM these studies, standards must be established and so set up that they can be readily identified with the products to which they pertain.

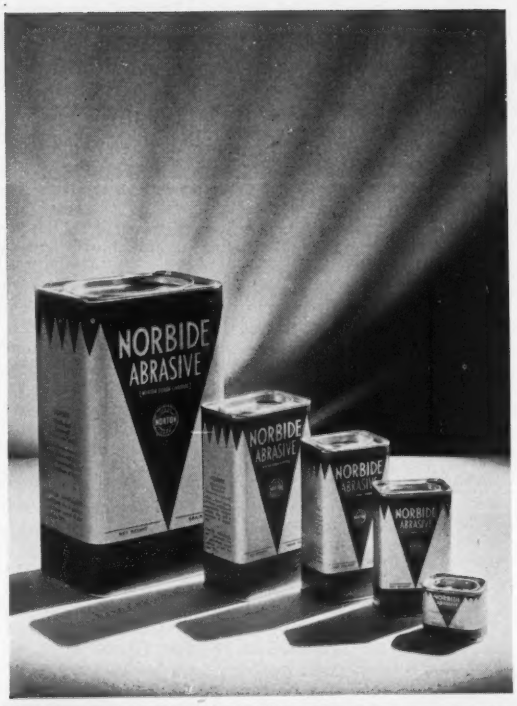
✦ ✦ ✦

THE accompanying sketch No. 1 suggests a form in which such standards may be set up. These standards are for Chain Link Looms and represent production in square feet of fabric per hour. Sketch No. 2 presents a similar arrangement for standards for wire drawing.

✦ ✦ ✦

AFTER production standards have been set up for each production center and for every product made, standard route sheets must be prepared for each product, showing all operations in their proper sequence, the machines on which the operations are to be performed, the time required to set up the machine for each operation, also, the running

(*Please turn to Page 195*)



NORBIDE
ABRASIVE

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Cemented
Carbide
Dies

Used in place of diamond dust it reduces the cost of shaping, ripping and finishing.

NORTON COMPANY
WORCESTER, MASS.

N—38

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Bell-Mine
Pulverized Lime

WARNER COMPANY Lime Bell Mine Products BELLEFONTE DIVISION

FOR WIRE DRAWING

"Bell-Mine" Lime is free from grit and other impurities
.....has a high guaranteed content of Calcium
.. is unusually slow settling in the milk of Lime Box
.. is truly economic in use.

Warner Company
BELLEFONTE DIVISION
SALES OFFICES: PITTSBURGH, PHILADELPHIA, BELLEFONTE, N. Y. CITY.

Meeting the Demand for Faster Production
Industry's Answer to the Emergency

"PLANT modernization offers an attractive opportunity to lighten the pressure on the labor market, to reduce costs and above all to maximize production per man-hour and man-year and make industry's contribution to defense one of the highest order" is the conclusion reached in a booklet, "Meeting the Demand for Faster Production", recently published by Farrel-Birmingham Company, Inc., machinery manufacturers of Ansonia, Conn.

✦ ✦ ✦

ACCORDING to the estimates of the authors, our wartime production needs, as measured in terms of man-hours of factory labor, must be revised upwards in the light of developments abroad. The booklet points out that:

"Wartime production needs of even twelve billion man-hours yearly, superimposed upon domestic requirements ranging in peacetime at fifteen billion man-hours, represent a total of twenty-seven billion man-hours. The increased hours of effort represent continuous production of some five million additional men, even counting a man-year as 2,400 hours. It is important to see the situation in that light; it is also useful to observe that probably not more than one-half such a number could be absorbed in manufacturing, considering both the limitations of factory floor space and the relative absence of a large supply of skilled and experienced labor. Approximate as such estimates must be, they nonetheless bring the problem into focus.

"The gradual decline in man-hours per unit of output between 1899 and 1919 and the sharp reduction between 1919 and 1931 came to an end in 1933. Since 1933 data from that source shows that no further gains have been made on the whole in reducing the labor time per unit of output! Instead, the former trend has shown signs of reversing itself.

"Coincident with, if not the most important cause of that trend, is the sharp advance in the average age of production machinery. From six to eight machines out of each ten in important defense industries are over ten years of age and do not have the improvements developed in the last decade. That condition, if corrected, might provide an increased productivity per man-hour equivalent to adding not less than one billion and perhaps as much as three billion man-hours of effort to factory processes.

"The possibilities of machinery modernization are substantially enlarged, we think, when the program provides means of consciously comparing present equipment, however mechanically efficient, with new designs embodying improvements in any or all of the following respects:

"Increases in speed of operation without sacrifice of precision or other quality requirements; increases in the degree of skill transferred to mechanisms; improvements which simplify disassembly, adjustment, cleaning and resetting; improvements which diminish the hazards or arduousness of operations.

"The foregoing four broad approaches provide both a basis for a systematic program of checking and a comparison of existing equipment with the new designs developed in recent years."

✦ ✦ ✦

Defense

AN ordnance office of the War Department has been established in Bridgeport, headed by Major Stuart Naramore. The office will handle all ordnance functions in a section comprising most of Fairfield county. Other sub-offices have been set up in New Haven, Hartford, Waterbury and Springfield where manufacturers may obtain any information they are seeking.

✦ ✦ ✦

THE Bridgeport office, which has assumed the administrative, fiscal, personnel, inspection, engineering and contract negotiation duties of the main office, is now located in the Bridgeport Brass Company plant, but is expanding so rapidly that it will be necessary to move to other quarters within six weeks, the ordnance inspector stated.

IMMEDIATE RECOGNITION!
ACCORDED THIS FOUR-STAR BOOK

★ Practical ★ Original ★ Interesting ★ Complete

From all quarters has come commendation of this latest ASM book on practical metallurgy. Already four famous engineering schools—Case School of Applied Science . . . University of Wisconsin . . . Brooklyn Polytechnic Institute . . . Stevens Institute of Technology — are planning to use this book as a textbook for their courses in metallurgy.

Typical of other responses is that from Dr. Zay Jeffries, General Electric authority, who says: "The book constitutes a valuable addition to the literature of metallurgy".

If you haven't ordered your copy, do so today. You'll agree when you receive "Practical Metallurgy" that this is the finest book on this subject available today.

PRACTICAL METALLURGY

Applied Physical Metallurgy — Industrial Processing of Ferrous and Nonferrous Metals and Alloys

by

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Case School of Applied Science
and
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570 Pages . . . 355 Illustrations . . . 6x9 . . . Red Cloth Bound

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In addition to 335 general illustrations, PRACTICAL METALLURGY contains 160 constitutional diagrams covering all systems that contain an important commercial alloy. These diagrams . . . the chapters on Plastic Deformation of Ferrous and Nonferrous Metals . . . and the chapter on Internal Stress in Metals contain information not available in any other book published in this country.

Here is the book you've long wanted — a simple yet complete treatise on practical metallurgy.

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DIAMOND WIRE DIE MAN AVAILABLE

Satisfactory inducements will make available a man with 27 years' experience in all phases of die work including selling. Also practical wire mill experience. Honest, capable, American. Apply Box 325.

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SITUATION WANTED:

FACTORY MANAGER — PRODUCTION ENGINEER or PLANT ENGINEER—Graduate Engineer with broad industrial management and engineering experience in ferrous and non-ferrous wire and wire products, wood, rubber and other industrial products. Reply Box 326

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FOR SALE

One twelve tube Strand Annealing Furnace suitable for use with atmospheres.

Production, 1250 pounds per hour, gas fired, with automatic control, heavy construction, with efficient linings. One lead bath for quenching at discharge end of annealing furnace, one tinning furnace; blower, with sufficient capacity for the above furnaces. Reply BOX 327

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ANNOUNCING

Combined Wire Drawing and Electric Annealing Machines in Operation, 30 to 36 B&S at 7000 ft. per min.

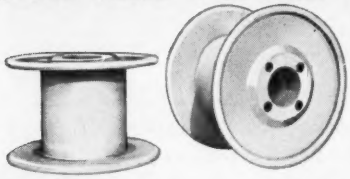
ALSO—

Combined Wire Drawing, Electric Annealing and Continuous Spooling Machines in Operation, 14 to 18 B&S at 3000 ft. per min.

Machines Under Construction 8 to 16 B&S at 2500 ft. per min.

JOHN COOK ENGINEERING COMPANY
265 North 9th St., Prospect Park
Paterson, N. J.

APCO MOSSBERG
STEEL REELS & SPOOLS



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Apco Mossberg Steel Reels are standard equipment in the wire industry—and for good reason! Apco Mossberg—the original Frank Mossberg Co.—**originated** the steel reel idea and have been training workmen in their manufacture ever since. Personal attention by Apco Mossberg engineers make each job a "special".

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We will gladly submit drawings, blueprints, or suggestions without obligation to you. Write for quotation today.

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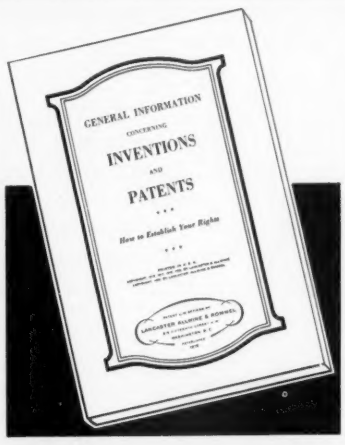
(The Original Frank Mossberg Co.)
21 Lamb Street. Attleboro, Mass.



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438 Bowen Bldg., Washington, D. C.

Keep Those Machines Running

(*Continued from Page 193*)

time required per unit quantity, as well as any special tools or instructions that may be necessary for the job so that there will be no guess work or mistakes in laying out a production schedule. These route sheets need not be of any specific form, just so they contain all of the required information.

✦ ✦ ✦

AFTER machine capacities have been ascertained and job time has been set up, the next step is to load the equipment. This loading is ordinarily done on a chart similar to that shown in Sketch No. 3. One chart is usually made for each month and these are posted on a board of sufficient length to permit three of them. That is, one for the past month, one for the present month and one for the next month, to be posted end to end, thus presenting a sort of perpetual picture. The number of months, however, that need be represented on the board at any one time must be governed by the nature of trade, and the backlog usually carried. The vertical columns of these charts represent the days of the months, while the horizontal spaces represent the various machines or production centers.

✦ ✦ ✦

AS production orders are entered and sent in to the shop, they are translated into productive hours for each machine over which the work is to flow. These hours are posted on the chart after each machine in the column of the day on which the machine is to be engaged in the work on order, care being taken that the total hours entered behind any one machine under any one day does not exceed the normal working hours per day of that machine. It is usually advisable to enter the order number adjacent to the hours in each space in case it is necessary to alter the schedule before jobs are completed due to unforeseen delays, material shortages, breakdowns, or employee absence. Causes for

METAL SHIELDED WIRE (PATENTED)

A NEW METHOD OF PROTECTING INSULATED WIRES

Seamless ALUMINUM or COPPER Tubing is Drawn over the Wire or Wires in such a manner that ANY kind of a bend can be made and the ends easily trimmed.

Gives Positive Protection to the Wire against Corrosion, Acids, Oils, etc. ★ Pliable, Compact, Light in Weight and Protects Mechanically like Armor. ★ Produces added Stiffness yet can be bent to shortest Radii. ★ Outside Diameter can be held to close Tolerances and any required wall thickness can be made.

SEND FOR FREE SAMPLES

PRECISION TUBE CO.
Specialists in Accurately drawn Seamless ALUMINUM, COPPER and BRASS Tubing in the Smaller Sizes.
3824-26-28 TERRACE ST.
PHILADELPHIA, PA.

Longer Die Life, Brighter Wire, Shorter Baking Time

Today's urgent necessity to speed-up production makes it important to investigate every method, material or new development that helps achieve this end.

In many well-known wire mills the standardized use of Oakite Composition No. 24 and other Oakite materials for de-greasing and drawing wire has resulted in longer die life, brighter wire, shorter baking time and other advantages. We shall be glad to work with you and make tests to help you establish the same results in your mill.

Since there is no obligation, won't you write us today?

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Representatives in all Principal Cities of U. S. and Canada

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Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

STEELSKIN

REG. U. S. PAT. OFFICE

For High or Low Carbon Wire

WIRE DRAWING SOAPS

Established 30 years

R. H. MILLER CO., Inc. Homer, N. Y.

"STANDARD WIRE DRAW"

FOR HIGH-LOW CARBON, BRIGHT, COLD HEADING
WET WIRE DRAWING

- Lower die costs
- Better finished wire
- Lubricants specially adapted for drawing on high speed machines

EXPERIENCED SERVICE MEN WILL DEMONSTRATE
THE MERIT OF OUR PRODUCTS

STANDARD INDUSTRIAL COMPOUNDS CO.
4600 Ferdinand St. Chicago, Ill.

SPRINGS MADE ON CONTRACT

Contract work done with your stock. Facilities for forming springs, short or long lengths. Work shipped back promptly, finished or semi-finished, as specified.

Also do blanking, stamping and special shapes in quantity to order, and rubber covering of metal articles.

Send all communications to the address below.

AMERICAN WIRE PRODUCTS COMPANY
4824 3d Ave., Brooklyn, N. Y. • Bush Terminal Sector

Keep Those Machines Running

(*Continued from Page 195*)

such delays are usually coded and shown on the chart to signify lost time and the date of its occurrence.

✦ ✦ ✦

WHERE it is customary for a department or a machine to operate more than one shift, the horizontal spacings should be divided, of course, so that the loading of each shift can be done separately. As production is accomplished, these charts are unloaded from the machine report shown in Sketch No. 4 which is used in conjunction with them. The reports are filled out by department foremen at the end of each shift indicating just what activity was maintained and the reasons for lost time if any. Lost time is usually posted to the chart with red pencil or red ink so as to make its occurrence conspicuous. After postings have been made to the charts each day from the machine reports, the production clerk in charge makes note of the machine reports and forwards them immediately to the superintendent or factory manager.

✦ ✦ ✦

IT is the superintendent or factory manager's function then to investigate all causes of lost time with a view towards preventing their reoccurrence and to authorize over time or whatever is necessary to bring the schedule back up-to-date.

✦ ✦ ✦

IT is more difficult in some industries than others to control the factors which govern or influence machine activity. The wire industry, however, in view of the high degree of mechanization, lends itself readily to the application of controls in most if not all of its branches. Management, must insist on such controls if they expect a high degree of efficiency. Selfish motives or personal characteristics have lead some individuals to explore and to succeed with these methods. Their success proves that it can be done.

Sheffield Steel to Operate New Armco Texas Plant

CHARLES R. HOOK, president of The American Rolling Mill Company, has confirmed the announcement of Wm. S. Knudsen of the National Defense Commission that Armco would build a steel plant on the ship canal near Houston, Texas.

✦ ✦ ✦

IT was stated that the Texas steel plant would manufacture billets for shell forgings, structural steel, light plates for shipbuilding, wire, rods, oil field supplies, and other items necessary to national defense.

✦ ✦ ✦

THE plant will consist of three 100-ton open hearth furnaces, a billet and structural mill, a rod mill, merchant bar mill, 84-inch plate mill, wire mill, and auxiliary equipment. It will have an estimated annual capacity of 200,000 ingot tons.

✦ ✦ ✦

OPERATIONS of the new plant will be managed by the Sheffield Steel Corporation, another Armco subsidiary which operates plants in Kansas City and St. Louis, Mo., and Tulsa and Sand Springs, Oklahoma. R. L. Gray, president of the Sheffield Steel Corporation will become president of the Texas Corporation. Charles R. Hook will be chairman, and Calvin Verity, vice president and general manager of Armco, will be vice chairman.

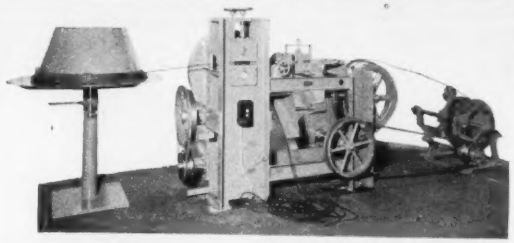
✦ ✦ ✦

Electrical Machinery & Equipment

EXPORTS of rubber-covered wire to all countries totaled $194,971 in December, as compared with $175,568 in November, an increase of 11 percent. Other insulated copper wire was valued at $354,431, a decrease of 24.4 percent from the November shipments of $468,860.

✦ ✦ ✦

EXPORTS of accessories and parts for generators were valued at $220,188 in December, the high mark of the year for this classification, and an increase of 329.6 percent from the November total of $51,250.

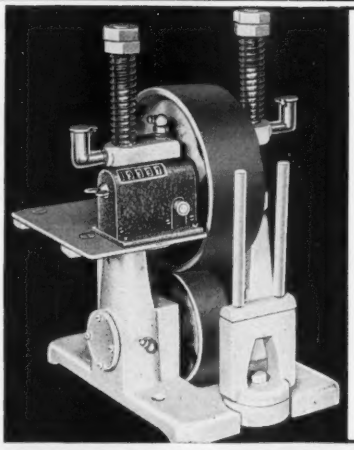


INSULATION WIRE STRIPPER

EST. 1885 Armco INC. 1918
"American" INSULATING MACHINERY COMPANY
517 West Huntingdon St.
PHILADELPHIA PENNSYLVANIA U.S.A.

for reclaiming weather proof wire from open coils. Removes covering, straightens the wire and winds with traverse on reels.

Motor driven, ball bearing throughout and mounted on welded steel frames.



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INACCURACY and LOSS!

It's essential to know at all times the exact production of your machines. Productimeter Wire Measuring Units give you accurate lineal count instantly. Many models to choose from . . . the Productimeter Line is the most complete ever offered.

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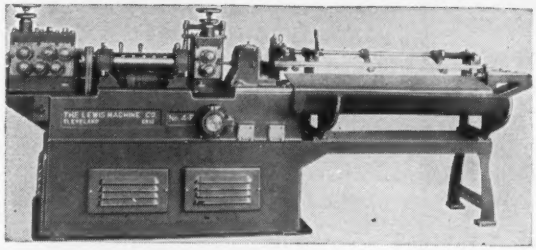
SEND FOR YOUR COPY TODAY!

At left "Type M" . . . sturdy, dependable . . . no adjustment necessary . . . most accurate two-wheel measuring machine made.

DURANT MANUFACTURING CO.
1918 N. Buffum St. Milwaukee, Wis. • 176 Eddy St. Providence, R.I.

LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



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The Sign of Dependable Service:
WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

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NILSON AUTOMATIC PRESS AND FOUR SLIDE MACHINE
FOR SWAGING, STAMPING, PIERCING, BLANKING, FORMING OF COILED METAL

WE also build machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc., and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.

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THE A. H. NILSON MACHINE CO.
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Diamond Dies

Skill and accuracy in manufacture with the use of selected stones make Balloffet Diamond Dies the choice of the most critical users.

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Quality Diamond Dies
Since 1870

BALLOFFET
DIES AND NOZZLE CO., INC.
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Guttenberg, New Jersey

Defense Needs Create Diamond Import Record

Value Put at $10,885,664 in 150% Rise Last Year

IMPORTS of industrial diamonds for defense production purposes reached an all-time high of 1,676 pounds during 1940, according to a report of the Bureau of Custom Statistics released yesterday. Valued at $10,885,664, the stones are used for machine tooling in the production of defense materials, such as airplane parts and gun bores.

✦ ✦ ✦

NINETY per cent of the imports came from Africa. The rest were imported from Brazil, British Guiana and other South American countries. Information from the London diamond market, according to the report, indicates that large scale deliveries in 1941 to United States manufacturers and industrial diamond dealers are continuing on a regular schedule.

✦ ✦ ✦

AMONG the varieties of industrial diamonds received in large quantities was crushing bort, or imperfect diamond, which is found only in Africa and is important as a source of the diamond powder used to grind range finders, bomb sights and navigation instruments. The 1940 imports, totaling 3,801,834 carats, represent an increase of more than 150 per cent over the pre-war years from 1936 to 1938, when the average annual supply was 1,500,000 carats.

Diamond Dies Purchased by U. S. Government

TO meet a shortage of diamond dies in the wire drawing industry and acting upon the recommendation of the Office of Production Management, Director of Priorities, **E. R. Stettinius, Jr.,** has announced the authorization to purchase from the British Purchasing Commission, approximately 6,000 small unset diamond dies.

✦ ✦ ✦

THE distribution of the dies will be made by the Defense Supplies Corp., and inquiries should be directed to that organization at Washington, D. C.

DIAMOND DIES
.000's to .102
Fort Wayne Wire Die, Inc.
2002 S. Harrison Fort Wayne, Ind.

DIAMOND CARBIDE
DIES
KELLY
WIRE DIE CORPORATION
19 W. 34th St. New York

Wire Drawing and Extrusion Dies made of
DIAMONDS, COMPOSITION, etc.
F. KRAUSE & COMPANY, INC.
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Phone JOurnal Square 4-5105

FOR DIAMOND AND CARBIDE WIRE DRAWING DIES SEE
RUSCH WIRE DIE CORPORATION
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Wire Drawing Diamond Dies
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WIRE DIE CORPORATION
300 W. 56th St., NEW YORK
Tel. Col. 5-1340

Use The Quality WAYNE DIE
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Write us today for prices and particulars.

Accuracy, long life at high speed and dependability is built into each Wayne die by skilled craftsmen, experienced in the making of quality dies. Only the best quality diamonds are used.

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Largest Stocks in U. S. A.
VIANNEY
Famous Wire Drawing Diamond Dies
250 E. 43rd St., New York

Use Pittsburgh Wires for *Every* Fabricating Purpose
PITTSBURGH STEEL COMPANY
1641 GRANT BUILDING PITTSBURGH, PA.

UNIVERSAL WIRE REEL

Quickly and easily adjusted to any angle within 90 degrees. Cut shows one angle.
Write for circular R

THE F. B. SHUSTER CO.
New Haven, Conn.
Straightener Specialists Since 1866

Continuous Straightening and Cutting Machinery
With
FLYING SHEAR
for round and shaped wire.
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THE HALLDEN MACHINE COMPANY
THOMASTON CONNECTICUT

Wire Drawing Machinery

Featuring —
High Speed Upright Cone Machines.
Also —
Bull Blocks and Benches, Continuous Wire Drawing Machines, Spoolers, Pointers, String-up Machines, etc.
And —
Cold Heading Machinery.

WATERBURY FARREL FOUNDRY & MACHINE CO.
Waterbury, Conn.

Hy-Carbo Steel Co.
Est. 1917
✦ ✦ ✦
HIGH GRADE CUSTOM WIRE DRAWING
In Rounds
Less Ton Lots A Specialty
✦ ✦ ✦
LOWELL, MASS.

Bethlehem Doubles Rod Making Capacity at Sparrows Point

(*Continued from Page 175*)

has perforations in it to make the loops on the lower repeater plainly visible.

✦ ✦ ✦

RODS from the new finishing train are delivered by water-cooled connecting pipes to four new automatic laying reels, capable of producing coils of 46 in. outside diameter and 34 in. inside diameter. Two reels of the pouring type have also been installed, for coiling the heavier sizes, from ⅜" to 1" in diameter, of rod and merchant bar which are not rolled in the finishing stands. The pouring reels produce coils of 46" outside and 36" inside diameters, in weights up to 900 lbs.

✦ ✦ ✦

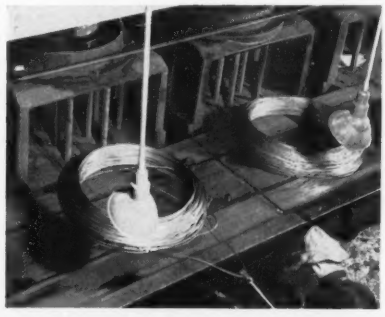

Fig. 4. No. 2 Rod Mill, Maryland Plant, Bethlehem Steel Company. Laying reels and chain conveyor.

✦ ✦ ✦

THE additional reels recently installed discharge upon a new conveying system which parallels the one serving the old finishing stands. This consists of an open, chain-type coil conveyor, 320 ft. long, and a 960 ft. hook carrier.

✦ ✦ ✦

A NEW station, 43 x 200 ft., to unload the hook carrier has been built adjacent to the coil storage. Here bundles from both hook carriers are discharged onto a shuttle conveyor which transfers the coils to a point directly under

(*Please turn to Page 200*)

GEORGE D. HARTLEY
CONSULTANT & SPECIALIST
In Wire Manufacturing & Wire Forming Equipment
Development & Research
New Processes — Designing
Inventions — Patents
372 MAY ST., WORCESTER, MASS.

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Wire Mill Equipment, Layout and Practice
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WIRE MACHINERY SPECIALISTS
3—Nilson No. 1, 3 & 4 4 Slide Wire Machines
2—Baird No. 3 & S3F 4 Slide Wire Machines
7—Waterbury Step Cone Wire Drawing Machines
1—Two Spindle Bull Block Motor Driven
6—Lewis Welding Wire S & C Machines M. D.
2—Shuster Shaped Wire S & C Machines ½" & ⅞"
8—Shuster Round Wire S & C Machines 1/32"-½"
Wanted: Tack Making Machinery. All Sizes.
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Everything for the Wire and Cable Industry.
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NEW ENGLAND BUTT CO.
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In rolls of any size for wrapping coils and reels.
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"THE SHIFTWEIGHT"
TILTING WIRE REEL
One man loading reel = for wire coils up to 300 pounds.
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THE PLATT BROS. & CO.
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Designers and Builders of Gas-Fired Heat Treating Furnaces for Ferrous and Non-Ferrous Wire.
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Wire, Tube, and Brass Mills
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General Castings for Wire Mill use. Circulars on Request.
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Wire Mill and Cold Rolling Equipment
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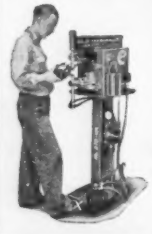
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Annealing Pots and Boxes
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Lead and Spelter Pans
Pressure Vessels
NATIONAL ANNEALING BOX CO.
Established 1895
Washington, Penna.

Bethlehem Doubles Rod Making Capacity at Sparrows Point

(*Continued from Page 199*)

an overhead tramrail system where these bundles are picked up by hairpin hooks and carried to the loading platform or to storage bins. To take care of the increased output a four-bay extension of the coil storage building, 75 x 100 ft. with overhead tracks and carriers, has been made, increasing the capacity by about 2000 tons.

✦ ✦ ✦

THERE are twenty-one active passes in operation when No. 5 gauge rod is rolled, from 2-in., 2¼ in., or 2½ in. billets, 30 feet long. The eight laying reels, in batteries of four each, receive sizes up to ⅜" in diameter and alternately coil the four bars.

✦ ✦ ✦

BARS ⅜ in. and larger are rolled on a two-strand schedule, and are delivered from the fifteenth stand to four pouring reels, arranged in groups of two each. Bars rolled double strand may also be delivered in straight lengths to a 300 ft. double cooling bed. Bars over ¾ in. and up to 1⅛ in. are rolled singly from 3 in. square billets for straight delivery to the cooling bed, whereas bars ¾ in. and smaller are rolled double strand, each strand being delivered to one side of the bed.

✦ ✦ ✦

THE space occupied by the new finishing mill formerly served as roll storage space. A new building, 75 x 145 ft., has been built adjacent to the mill, to provide room for roll set-ups and spare bearings. This building is equipped with an overhead crane and a motor driven transfer car. A 100 x 225 ft. extension to the yard has increased the billet storage capacity by approximately 8000 tons.

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BUILDING EXTRUDERS SINCE 1880
Insulating Machinery for Western Electric Continuous Vulcanizing process.
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PATERSON, N. J.
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FOR
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WRAPPING MACHINES
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The Annual Dues Are $10.00—For detailed information address
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WIRE MACHINERY COMPANY
SUBSIDIARY OF
THOMSON-GIBB ELECTRIC WELDING COMPANY
LYNN, MASSACHUSETTS
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ABRASIVES—
Norton Co., Worcester, Mass.

ACCUMULATORS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio.

ANNEALING MACHINES—Open Flame
Drever Co., The, Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ANODES—Nickel
Seymour Mfg. Co., Seymour, Conn.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

AUTOMATIC SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, O.
Morgan Construction Co., Worcester, Mass.
Moslo Machinery, Inc., Cleveland, O.
Ross, J. O., Engineering Corp., New York, N. Y.

BANBURY MIXERS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.

BERYLLIUM COPPER—Strip and Bars
Callite Tungsten Corp., Union City, N. J.

BLOCKERS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CALIPERS—Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CASTINGS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Lee Wilson Engineering Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

CLOTH—Wire, All Metals
Callite Tungsten Corp., Union City, N. J.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.

COILERS AND SPOOLERS FOR INSULATED WIRES—
Entwistle, James L., Pawtucket, R. I.

COLD HEADERS—
Waterbury Farrel Fdry. & Machine Co., Waterbury, Conn.

COMPOUNDS—Wire Drawing
Standard Industrial Compounds Co., Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WHERE TO BUY, Continued

CRANES—Wire Mill
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIAMONDS—Industrial
Callite Tungsten Corp., Union City, N. J.

DIAMOND POWDERS—
Rusch Wire Die Corp., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Co., New York, N. Y.
Fort Wayne Wire Die, Inc., Fort Wayne, Indiana.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Inc., Jersey City, N. J.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Fort Wayne Wire Die, Inc., Fort Wayne, Indiana.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Inc., Jersey City, N. J.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn.
Entwistle, James L., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLASH BAKER—
Carl-Mayer Corp., The, Cleveland, Ohio

FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, O.
Drever Co., The, Philadelphia, Pa.
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, O.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Hardening and Tempering
Carl Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, O.
Surface Combustion Corp., Toledo, Ohio.

GALVANIZING EQUIPMENT—
Lee Wilson Engineering Co., Cleveland, Ohio

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Pa.

GATES—Blast, For Low Pressure Air
Farrel-Birmingham Co., Inc., Ansonia, Conn.

GEARS—Continuous Tooth Herringbone
Farrel-Birmingham Co., Inc., Ansonia, Conn.

GEARS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.

GRINDERS—ROLL
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Norton Co., Worcester, Mass.

HI-SPEED BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.

HOISTS—Electric Traveling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

INSTRUMENTS—Electrical
Entwistle, James L., Pawtucket, R. I.

KETTLES—Galvanizing, Annealing, Tinning, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—
Warner Co., The, Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Miller, R. H., Co., Homer, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Miller, R. H., Co., Homer, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Entwistle, James L., Pawtucket, R. I.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Cook, John, Engr. Co., Paterson, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
Moslo Machinery Inc., Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Draw Benches
Standard Machinery Co., Providence, R. I.

MACHINERY—Edging
Standard Machinery Co., Providence, R. I.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.

WHERE TO BUY, Continued

MACHINERY—Galvanizing
Lee Wilson Engineering Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Lee Wilson Engineering Co., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Grinding, Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY — Measuring Wire & Cable
Davis, R. L., Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Paper Covering Wire
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Royle, John & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
Moslo Machinery, Inc., Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Davis, R. L., Electric Co., Wallingford, Conn.

MACHINERY—Testing—Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
Micro Products Co., Chicago, Ill.
Shuster, F. B., Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt, Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Cook, John, Engr. Co., Paterson, N. J.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt, Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MILLS—Rod, Bar, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MILLS—Strip, Hot and Cold For Iron, Steel, Copper, Brass, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OILS—Wire Drawing
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Industrial
Carl-Mayer Corp., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Inc., Newark, N. J.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS
American Chemical Paint Co., Ambler, Pa.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

WHERE TO BUY, Continued

POTS—Lead Melting
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Pa.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

RECORDERS—Fault and Reel
Entwistle, James L., Pawtucket, R. I.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery, Inc., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Constant Tension
Farrel-Birmingham Co., Inc., Ansonia, Conn.

REELS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B. Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products, Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS
Carl-Mayer Corp., The, Cleveland, O.
Moslo Machinery, Inc., Cleveland, O.
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

ROLLS—Iron, Steel, Alloy
Farrel-Birmingham Co., Inc., Ansonia, Conn.

ROLLS—For Strip, Rod, Bar Mills
Farrel-Birmingham Co., Inc., Ansonia, Conn.

ROLL STRAIGHTENERS—
Moslo Machinery, Inc., Cleveland, O.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Indiana.

SOAPS—Industrial and Wire Drawing
Miller, R. H., Co., Homer, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

SPOOLS—Annealing and Wire Drawing
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TAKE-UPS FOR CABLE, HOSE, LEAD PRESSES AND SHEET RUBBER—
Entwistle, James L., Pawtucket, R. I.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURK HEADS—Friction and Power Driven
Standard Machinery Co., Providence, R. I.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, O.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE DRAWING — High Grade Custom
Hy-Carbo Steel Co., Lowell, Mass.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Firth-Sterling Steel Co., McKeesport, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Metal Shielded
Precision Tube Co., Philadelphia, Pa.

WIRE—Nickel Silver and Phosphor Bronze
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Firth-Sterling Steel Co., McKeesport, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Stainless Steel
Callite Tungsten Corp., Union City, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non Ferrous
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Inc., Newark, N. J.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

HUDSON WIRE CO. PLANT AT OSSINING, N. Y.

HUDCO

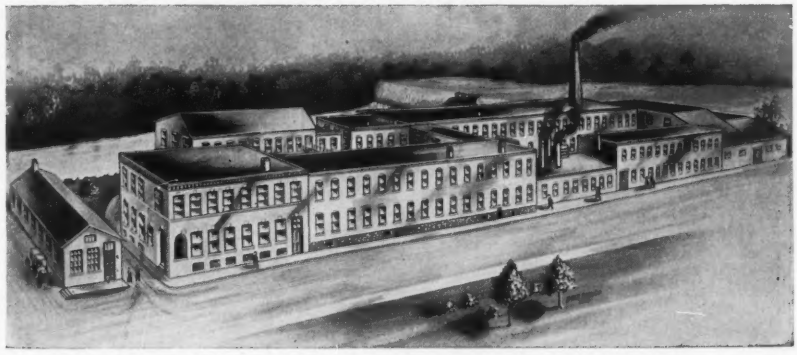
FINE WIRES IN ALL METALS

TWO MODERN AND COMPLETE WIRE PLANTS—— AT YOUR SERVICE——

LET US QUOTE ON YOUR WIRE REQUIREMENTS

WINCO

LEAKPROOF ENAMELLED WIRE



Winsted Divn. of HUDSON WIRE CO. at Winsted, Conn.

HUDCO

FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze, Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Tinsel Lahns, Silver Plated Copper, False Gold and Copper.

Cadmium, Nickel Silver, 10%, 18% and 30%; Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification, Metallic Fibre for Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum.

WIRES FOR METAL SPRAYING

Pure Lead, Lead Alloy, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire, High Conductivity, Electric Wire.

Cadmium, Nickel Silver, (10%, 18%, 30%); Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel, Commercial Bronze.

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from Selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing. BETTER WIRE AT LOWER COST.

LET US QUOTE

HUDSON WIRE COMPANY

OSSINING, N. Y.

SUCCESSORS ROYLE & AKIN

ESTAB. 1902 ESTAB. 1902

WINCO

LEAKPROOF ENAMELLED WIRES

Drawn from special oxygen-free copper that works so clean, so free from slivers, that enamelling is perfect. Leaks positively prevented. Every foot of WINCO enamelled wire is mercury tested before shipment to assure a wire perfect in every particular.

WINCO enamelled wire is covered to the same dimensions as fabric-covered wire so the user need not change his equipment. It will withstand softening in varnish-dipping and baking.

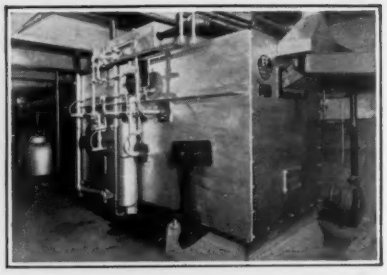
WINCO enamelled wire is lower in cost than silk covered wire. Write for sample.

LET US QUOTE

WINSTED DIVISION

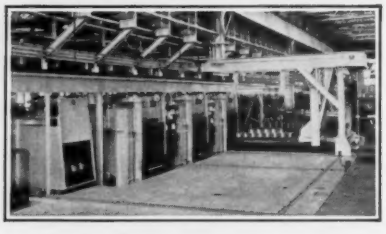
HUDSON WIRE COMPANY

WINSTED, CONN.

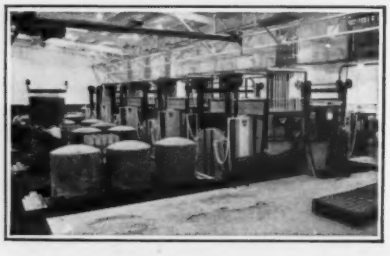


Machine Gun Cartridge Clips are heat treated uniformly, continuously, and scale-free in this E.F. special atmosphere continuous chain belt conveyor type furnace—one of a number of continuous furnaces built by The Electric Furnace Co., Salem, Ohio, adapted to heat treating arms and ammunition components.

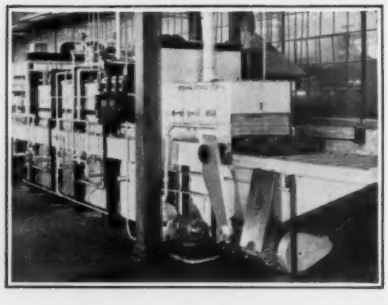
Airplane Propeller Blades and other aircraft parts are securely joined in this E.F. copper brazing furnace—one of a number of types of continuous and batch type installations made by The Electric Furnace Co., Salem, Ohio, for copper and brass brazing and silver soldering large and small assemblies.



Brass for Cartridges and other products are uniformly treated in various types of E.F. continuous, semi-continuous and batch type furnaces. The above installation shows 3 gas-fired, hearth type forced circulation furnaces with quench, cooling chamber and handling crane—one of several similar installations made in prominent non-ferrous plants by The Electric Furnace Co., Salem, Ohio.



Aircraft Engine Parts are nitrided in this battery of double-ended reciprocating type furnaces—part of the world's largest nitriding furnace installation. These furnaces were designed and built by The Electric Furnace Co., Salem, Ohio, and installed in a prominent U. S. aircraft engine plant.



Annealing Shells. Designed for annealing brass shells, this E.F. gas-fired continuous roller hearth furnace is also adapted to treating steel shells. Large shells are carried direct on rollers—smaller shells are loaded into pans on trays. Built in various sizes by The Electric Furnace Co., Salem, Ohio.

Our large and experienced engineering staff and ample manufacturing facilities enable us to make reasonably prompt deliveries. We Solicit Your Inquiries.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production